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U.S. ARMY RADCON TEAM PARTICIPATION IN THE 1985 SERVICE RESPONSE FORCE FIELD EXERCISE (SRFX)

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U.S. ARMY LABORATORY COMMAND

BALLISTIC RESEARCH LABORATORY
ABERDEEN PROVING GROUND, MARYLAND

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U.S. ARMY RADCON TEAM PARTICIPATION IN THE 1985 SERVICE RESPONSE FORCE FIELD EXERCISE (SRFX)

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The Commanding General, U.S. Army Materiel Command (AMC), through AR 50-5 for Nuclear Surety, is assigned the responsibility for planning, establishing and maintaining at least one Service Response Force (SRF) capable of responding to Army nuclear weapon accidents and incidents in CONUS.

During the week of 19-23 August 1985, an SRF exercise was conducted at the Savanna Army Depot, Savanna, IL. The purpose of this exercise was to provide a realistic setting wherein the SRF's capability to translate accident/incident response and assistance plans and procedures into physical actions could be practiced and evaluated. This report documents the participation of the U.S. Army RADCON Team in the 1985 SRF Exercise. It contains conclusions and suggestions for improved SRF functioning.

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CONTENTS

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I. Description of RADCON Team Participation

RADCON Team participation in the Service Response Force (SRF) Exercise, 1985, actually began when members of the team were asked for information on certain pieces of instrumentation. A RADCON team member not involved in the exercise acted as a consultant to the BDM Corporation in exercise design.

Mr. Edward F. Wilsey of the RADCON Team served as an exercise controller in the role of chief of radiation monitoring evaluation. It should be noted that although he was on-site before and through the exercise, Mr. Wilsey did *not* participate in the RADCON Team activities until the writing of the after-action report.

Notice of the Commencement of the Exercise was received by Mr. John R. Jacobson at approximately 0920 on 19 August 1985. A copy of the RADCON Information Prompter Forms, RC1, RC2 and RC3, as executed for the exercise, are contained in Appendix A.

Having anticipated the exercise, the team had made arrangements to have a truck from BRL Support pick up needed equipment at 1030 hours. A list of equipment is presented in Appendix B.

The team left BWI at 1330 hours, non-stop to Chicago. There, GSA vehicles (all of which had to be returned on Friday in order to be available for reissue on Monday) were boarded for the stochastic trip to Savanna Army Depot (SvAD).

The RADCON Team arrived at SvAD at 1830. At that time, the simulation was in a "time-out" status. It had been decreed that the game would only be played between the hours of 0700 and 1600. However, much planning and coordination took place after hours and at 0630 meetings. An example of such coordination was the in-briefing of RADCON Leaders Mr. Jacobson and Dr. J. Terrence Klopcic by the NAICO, LTC Terry Anderson, which took place in the field mess hall from 1900-2000 hours on the day of arrival.

At 0630 on Tuesday, 20 August 1985, the RADCON Team commenced field activities. Since the scenario portrayed an accident at an operating nuclear storage site (called the Midwest Army Depot, MwAD), an alpha team was assumed to be present. That team, portrayed by the alpha team from Sierra Army Depot, had already established a hotline and had performed a few, disconnected radiological surveys. In fact, the hotline was operating well and continued to do so throughout the exercise. The RADCON team did nothing more than verify its operation.

Topographical maps, updated to 1975, were available on Day #1. A limited number of poor quality blueprints of the area were also available; and - after many snafus, which drew the wrath of the On-Scene Commander (OSC) - a simulated Aerial Mapping Survey

(AMS) plot became available. Copies of these items are included in Appendix C. However, actual post-accident aerial photos, requested by the RADCON Team upon arrival from the NAICO and, by him, to the OSC never became available.

RADCON Team efforts for the following two and one half days (0630 hours 20 August 1985 - 1300 hours 22 August 1985) primarily involved radiological surveys and air sampler set-up and monitoring. Most of the early surveys were done in full RADEX gear and on foot.

It became very important to recognize the many problems caused by such an accident and to prioritize them in order to establish a precedence for the many missions demanding the attention of the RADCON Team. The RADCON leaders derived the following prioritization of problems:

1. Re-establish/insure the security of all nuclear weapons, including both those that survived the accident and those not involved.

2. Help any immediate victims of the accident.

3. Prevent the further spread of contamination to civilian areas.

4. Aid, as requested by civilian authorities through the OSC, in the assessment and clean-up of contamination in civilian areas.

5. Establish the details of contamination on the military post.

6. Advise and aid as instructed by the OSC in the military post clean-up.

It was with these priorities in mind that the RADCON team gave precedence to those efforts which established (the absence of) any further airbourne hazard. This allowed the security personnel around the contaminated area to function without masks and verified that the civilian surroundings were not being further contaminated by the air.

The second precedence of jobs was done concurrently. Base engineers, supported by the RADCON Team, began to control any run-off by "ditching" around the base and damming any outflowing depressions to form "catch-basins." Radiation monitors from the RADCON Team supported these actions. (In fact, since the engineer efforts were simulated as being done by the "night crew," RADCON support was as effortless as it was flawless.) The other job, actually enacted, was to begin removal of loose contaminant from the roads in the nuclear storage areas to allow resumption of motorized patrols and truck access without the hazard of resuspension. In this effort, a large (simulated) road/ runway vacuum cleaner (affectionately know as the "Super Sucker") was used. RADCON monitors recorded contamination levels before and after sweeping, as well as performing air sampling on the effluent from the Super Sucker filters.

The third priority of jobs, also done concurrently, was to continue to map the contamination on post. This effort was designed to help the DOE personnel in the Joint Radiological Coordinating Center (JRCC) gauge the extent of the hazard remaining and to aid in planning the clean-up and return to function of the post.

These actions were on-going at the end-of-exercise, approximately 1300 on 22 August 1985.

In the above discussion, it must be noted that the term RADCON Team refers to the BRL resident team augmented by the alpha team. Although the alpha team kept its titular leaders (Mr. Lane and Mr. West), the RADCON task teams, which were planned and led by BRL RADCON members, generally contained Sierra Alpha Team members.

The RADCON Team Leaders were also in frequent contact with the NAICO or his designated representative (CPT Wardynski), responding to questions and ad hoc assignments. Survey results were reported to the JTCC at 1100 hours and 1350 hours daily.

RADCON personnel established the inter-standardization of detectors, especially FIDLERS. FIDLER count-rates were related to micro-grams of plutonium per square meter using the Hewlett-Packard 41CX program FIDLER, enclosed in Appendix D.

RADCON personnel, through the NAICO, supplied technical advice to the OSC on contamination disposal. Mr. Markland, RADCON Health Physicist, was particularly noteworthy in this role. Mr. Markland had brought a portable computer, property of the BRL HPO, which was used as a word processor to convey information on rad waste disposal to the OSC through the NAICO. (See RADCON recommendations, below.) An example of an information message is shown in Appendix E.

Finally, Dr. Klopcic and Mr. Wilsey participated in the writing of the official after-action report. This participation included pre- paration of a list of four recommendations, contained in Appendix F, and a collection of information papers on RADCON capabilities and contamina- tion detection, contained in Appendix G. In the work session that followed, the RADCON representatives took exception to certain suggestions submitted by other participants. A discussion of the rebuttals tendered is contained in the section on after-action report, below.

II. Hotline Movement

One of the initial important tasks for the Alpha/RADCON Team is to establish the closest point to the accident site at which personnel can operate at minimum radiological risk: If possible, it is at this point that the hotline is established. The considerable burdens associated with operations on the hot side of the hotline and the frequent need to return to the cold side make hotline proximity to the accident site essential.

The Sierra Alpha Team apparently is well aware of the need for hotline proximity and set-up the hotline as close as allowed. However, the hotline location must also lie outside the largest explosive-safe distance (the "frag distance") associated with the most potent high energy (HE) explosive hazard that remains. In this exercise, render-safe procedures were not completed on the largest HE threat until Tuesday noon, and on the remaining HE threats until Tuesday evening. As a result, hotline locations were at 5500 and 1500 feet from the accident site until a final set-up of a hotline was effected Wednesday morning. At that time, the hotline location was determined by the "3 x background" contamination level, which placed it just outside the "sallyport."

At the time that the final hotline location was established, a decontamination area was set up immediately inside the hot area. Engineer crews were directed to ditch around the area to create a holding pond for any run-off. It was also in this area that the Super Sucker sweepings were unloaded into the barrels listed in Appendix E.

III. Debriefing by MG Harper

On Friday, MG Harper, the OSC, held a post-action debriefing. Dr. Klopcic from the RADCON Team and Mr. Wilsey from the Controllers were in attendance.

The session began with brief observations/comments from representatives from the various participating groups. A synopsis follows:

COL Fenwick, Cmndr SiAD: Mostly administration and public relations issues.

COL Stuart, Asst. OSC:

1. Some integration of teams, especially in the Emergency Operating Center (EOC) was poor.

2. Realism was lost when too many requests were being turned down by controllers.

Mr. Roeder, DOE: Happy to be invited.

Dr. Klopcic, RADCON: (See recommendations, Appendix F.)

COL Murphy, DNA:

1. Legally, the ARMY has authority only on the depot and in a National Defense Area.

2. Civilian Population: Evacuate as soon as possible - otherwise they'll do it themselves, a procedure fraught with panic.

Mr. Orndorf, Controllers: Kudos are due, especially to EOD and RADCON(!)

Following these remarks, MG Harper summarized his findings:

1. The realism of the exercise (at the EOC(?)) was good, but fell very short in simulating the chaos that would reign in a real situation.

2. Communications: Nice try, but inadequate. Certainly an Army that can set up commo for a division headquarters in a battle zone can get enough commo to the personnel in the EOC.

3. Public Affairs Officers: Every commander should practice being harassed; OSCs must get tough. The best training aid is a video-tape camera. Let the OSCs see themselves: Are they convincing to the public?

4. OSD/OPSEC: It's foolish to tell the citizens of a municipality near a depot that we don't admit that nukes are stored at the depot: the mayor of the town carried them around on a forklift before he retired!

5. Should extend the scenario to include higher headquarters.

6. Ad hoc capability: I (MG Harper) am amazed at HOW WELL RADCON and other teams come in and take over, coordinate, etc. We should formalize those procedures that work to insure that they stay in place. (This referred to Dr. Klopcic's comments on the maintenance of the chain-of-command through constant contact with the NAICO/NAICO representative.)

7. State and Local Agencies must be integrated, in advance, into the overall plan of action. There should be prepared, in advance, a directory of local civilian authorities and what they could do in an emergency.

8. Money. He had the authority to order just about anything that was needed to meet the emergency. However, he did not have the ready cash to effect quick settlement of civilian claims. Such authority would have enabled him to avoid long-standing legal hassles.

9. Finally, we approach the problem of a Broken Arrow (an accident involving the release of radioactive contamination) from an introverted perspective: We look at it from the Army depot viewpoint, whereas - through the media - the REST OF THE WORLD sees it from the local community viewpoint. That requires thought and realignment of approaches at the higher levels.

IV. **After-action Report**

Mr. Wilsey and Dr. Klopcic participated in the preparation of the SRFX after-action report. This effort, chaired by Mr. George Yantosik, began by separating all the written comments which had been submitted by the participants into interest areas: radiation control, medical, legal, etc. The after-action committee (approximately 30-40 individuals) divided into interest groups to review the written comments and coalesce the duplicates into a collection of observations for the record.

Since the published SRFX report will contain the results of these labors, a complete account of all radiation control submissions will not be attempted here. However, certain out-of-the-ordinary items will be discussed:

Mr. Wilsey and Dr. Klopcic dissented with certain recommendations submitted by some individuals. In order to avoid that appearance of "strong-arming" such recommendations out of the report at this stage, it was decided that dissenters could submit rebuttals to accompany the dissented opinions.

The major recommendations that were dissented by RADCON Team representatives were:

1. A suggestion (from Dr. Bramlett) that more use be made of the AMS data. Dissent, written by Mr. Wilsey, used actual plots from NUWAX 83 to show the potential for large errors that could be introduced by such a practice. When one recalls the heavy emphasis on public information, the reliant use - which would invariably lead to public release - of an AMS plot could put the Army in a very bad light, indeed.

2. A suggestion from the individual responsible for ARAC plots that those plots be used more extensively. Rebuttal as above.

3. Another suggestion from the ARAC proponent: Coordinates for the accident site report be in "standard" northing-easting coordinate system. Rebuttal from Dr. Klopcic: The system used to report the accident was in the standard military map sheet, six-digit coordinate system. It is unreasonable that the reporting military officer, who occupies his position temporarily and will probably NEVER in his life actually report such an incident, will learn a new coordinate system in order to please ARAC. It would be much more sensible for the individuals at ARAC, who 1) are permanent and 2) have essentially unlimited time and computing facilities, to derive the necessary (linear) translation algorithm to incorporate into the standard ARAC software.

4. Another comment from Dr. Bramlett stated that "There was a general lack of knowledge on transportation requirements and radioactive waste disposal..." Rebuttal from Klopcic observed that Dr. Bramlett must have been referring to the capability present at the EOC. A copy of the message in Appendix E was attached to support the claim that such a lack was not present at the actual accident site.

Two potentially serious problems also came to light at this time. It was found that a discrepancy exists between the RADCON Team instructions, as listed in FM 3-15 and the Nuclear Accident Response Plan (NARP). The NARP indicates that the OSC will establish the JRCC which will "DIRECT" the collection of radiological survey data, etc. The JRCC may be headed by members of the DOE response team, e.g. However, FM 3-15 states that the RADCON Team works directly for the OSC/NAICO. Since the NAICO most likely will not attempt to head the JRCC too, a conflict exists. This has serious implications for RADCON, since life as a DOE gopher wouldn't have the zest that being the OSC's advisors has. Written comment by Klopcic and LTC Anderson: This conflict must be resolved. In this exercise, the JRCC did not (for reasons of personality if not for reasons of utility) control the radiation survey activity. Rather, the JRCC served as an integrating center for the data that was being gathered by the simulatedly many Army, state and local teams. As such and being located at the EOC, it was a handy reference source on the radiological situation for the OSC. This appeared to the writers as a feasible and extremely useful function for the organization. It is also reasonable that such a function could be filled by non-Army assets.

A similar potential problem was alertly picked up by Mr. Wilsey while doing his homework for his controller tasks. In reviewing FM 9-15, "Explosive Ordnance Disposal Service and Unit Operations," he ran into the following statements:

> EOD service is SUPPORTED by: ... RADCON (radiological control) teams

and

Command and operational control is kept within the EOD organizational structure.

Again, the situation exists in which an "official" publication conflicts with FM 3-15 in its perception of the RADCON Teams upward chain of command. FM 9-15 was therefore included in the comments drafted for the after-action recommendations.

V. RADCON Team Suggestions

The RADCON Team also held a post-exercise briefing/brainstorming session. Twenty-three suggestions, contained in Appendix I were offered.

VI. Summary and Conclusions

The major conclusions from this exercise were:

1. The exercise provided valuable experience for the RADCON Team on the COLD side of the hotline. Examples were: interaction with a good NAICO, integration of the Alpha Team, and incorporation of clean-up recommendations/calculations into the play of new RADCONers.

2. The exercise was NOT good on the HOT side of the hotline. Having controllers accompany monitors and give readings is no substitute for detector calibration, electronic check-out and operation.

Several RADCON Team suggestions evolved from these conclusions. (See Appendix H.)

3. FM 3-15, the RADCON "bible," is in conflict with FM 9-15, the EOD counterpart, and with the latest NARP (Nuclear Accident Reaction Plan) in the important issue of command over the RADCON Team.

APPENDIX A

Information Prompter, RC1, RC2 and RC3

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RADCON TEAM (Information Prompter)

Questions to ask prior to or upon arrival at a Nuclear Accident/Incident - Formal Briefing should provide most information.

1. What is the nature of the Accident/Incident?	Broken Arrow-Midwest Army Depot, Helicopter crashed into truck carrying weapons. Multiple explosions.
2. Where is the Area Located?	Midwest Army Depot (MWAD) Vicinity Bldg. 310
Date and Time of Accident/Incident?	19 Aug 85 0735 PDT
Is the Accident on Government land?	Yes
Who made the discovery?	
3. Who is the On-Scene Commander?	Not requested yet
Where is he located?	MG Harper CG DESCOM
Telephone Contact?	EOC MWAD - Norm Fritz AUTOVON 585-8741 COM (815)278-8741
Where is the nearest military installation?	MWAD
Where is the nearest airfield?	Savanna Army Depot
4. Is nuclear criticality an issue?	Not known yet
Information regarding weapon assay available?	I requested it
What weapons(s)/nuclear sources (isotopes) were involved?	Line item 31 & 215 on truck Line item 31, 215, 300 in Bldg. 310
Was there a fire and/or explosion?	Yes/multiple
Was anyone hurt/killed?	Yes/no number available
Has the RAM Team been called?	Yes

(If yes skip to question(s) 7 next)

5. Has an EOD Team been called? yes SRI

   Have they arrived? Expected when? yes

   Team Point of Contact (Name)? ______

   Telephone contact? ______

   Have they been active in area? ______

   Their findings? just gone out

   Still EOD Hazard Area? ______

   Radio Exclusion? ______

6. Has an ALPHA Team been called? on scene

   Have they arrived? Expected when? ______

   Team point of contact (Name)? nothing

   Have they surveyed the Area? ______

   Their findings? ______

   Have they established a HOT-LINE? ______

7. Has the RAM Team arrived? no

   Have victims been monitored prior to removal from vicinity? ______

   If relocated where taken? ______

8. Is there currently an exclusion or security area established? ______

   Who administers this? ______

   Are there currently any personnel actions in or around the area? ______

   Have private citizens had access to the area? ______

   Have they left the area? ______

   To your knowledge has anything been removed or taken from the area? ______

9. What were the weather conditions at the time? Wind from South

Prevailing wind direction/speed? /

Any precipitation between then and now? __________

Where is the nearest population center relative to site? River City, CA

Nearest homes, schools, lakes, rivers, water supplies? Just off post

10. What local authorities are involved? Yes, extent not known immediately

Contacts/Telephone __________

What is the nature of their activity? __________

11. What are the current weather predictions? __________

What is the 24 hour/48 hour weather forecast? __________

Are access roads available? __________

Can road graders, scrapers, oil tanks water tanks, lift trucks- wenches, hardware supplies be obtained locally if necessary? __________

12. Are there currently any political considerations we should know about? __________

The above information obtained from Gerry Goldsborough Norm Fritz (Name), MWAD Emergency Operations Center (Authority), this 19 day of August (Month), 1985, at 0920 hours, EDT (Time Zone)

Signed JOHN R. JACOBSON

RADCON Team Leader
Position

Immediate action taken by the above as follows:

I notified BRL management and AMC HQ as required in FM 3-15 and the RADCON SOP. JNACC called at 0940 EDT 19 Aug 85 to alert RADCON Team. Mr. Tom Mead, AMC HQ released RADCON Team to MWAD at 1002 hrs EDT 19 aug 85.

Copies of this provided to:

RADCON TEAM LOG

NOTICE OF ALERT

1. **General**

(a) **Date and Time called** 19 Aug 85 0920 EDT 1320Z

(b) **Called by** Mid West Army Depot Emergency Operations Center

(c) **Agencies Included**

Team Only Alerted 0930 briefed 1000 departed 1100 19 Aug 85

BRL Admin Spt Division Notified 1010 19 Aug 85

APG Emergency Operations Center Notified 1020 19 Aug 85

AMC Initially notified of alert: 0932 hr EDT, 19 Aug 85: released to respond: 1002 hrs EDT 19 Aug 85

JNACC Called RADCON Team: team notified JNACC of departure 1050 hrs 19 Aug 85

Chief, VLD Notified 0930 hr of alert: 1010 of release by AMC

(d) **Time Team Assembled or Departed** 1000 hrs - Team leader briefed the situation; 1030 - Team loaded equipment; 1100 Team departed for airport; 1330 - Team departed BWI.

2. **Situation:**

VIP helicopter crashed into tractor trailer carrying two nuclear weapons. Multiple explosions followed and there was a fire which was extinguished. A special weapons maintenance area was also involved in which three weapons were being worked on. Initial Alpha Team survey confirmed extensive radioactive contamination.

3. **Recommendations:** Continue to follow emergency operations plan.

John R. Jacobson

OFFICIAL: JOHN R. JACOBSON

Name, Grade, or Title

GS-14, Physical Scientist

Form RC-1
February 1979

RADCON TEAM LOG

JOB ASSIGNMENT ROSTER

Team Composition:

Position	Name and Grade	Notified (Date - Time)
Team Leader --------------	John Jacobson	0930 EDT 19 Aug 85
Assistant Team Leader ------	Terry Kloncic	1000 EDT 19 Aug 85
Health Physicist ----------	Richard Markland	1000 EDT 19 Aug 85
Decontamination Specialist --	Murray Schmoke	1000 EDT 19 Aug 85
Administrative Assistant----	John Kammerer	1000 EDT 19 Aug 85
Monitor ----------------	John Anderson	1000 EDT 19 Aug 85
Monitor ----------------	David Neades	1000 EDT 19 Aug 85
Equipment Specialist -------	Mark Ralston	1000 EDT 19 Aug 85
Laboratory Technician ------	Carl Crisco	1000 EDT 19 Aug 85

(a) To accident site

N/A

(b) From accident site

N/A

DAVID L. RIGOTTI
Chief, Integrated Battlefield
Assessment Branch
OFFICIAL Vulnerability/Lethality Division
Name, Grade or Title

Form RC-2
February 1979

RADCON TEAM LOG

SCHEDULE SUMMARY

1. Date and Time:

   (a) Alert received 0920 EDT 19 Aug 85

   (b) Departed APG

   Advance Party N/A

   Team 1100 EDT 19 Aug 85

   (c) Arrival at accident site

   Advance Party N/A

   Team 1830 CDT 19 Aug 85

   (d) Relieved by NAICO 1330 CDT 22 Aug 85

   (e) Departed accident site 0630 CDT 23 Aug 85

   (f) Arrival at APG 1700 EDT 23 Aug 85

2. Advance Party Composition:
   N/A

Position	Name and Grade
Team Leader	
Monitor(s)	

JOHN R. JACOBSON
OFFICIAL RADCON Team Leader
Name, Grade, or Title

Form RC-3
February 1979

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APPENDIX B

Equipment List for SRFX 85

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RADCON Equipment Inventory

1.	PAC-1SA (AN/PDR-60)	8
2.	PIC-6 (hi range beta/gamma)	4
3.	BARK (FIDLER plus Ludlum 2220)	8
4.	Ludlum "Micro-R" (lo range gamma)	8
5.	Ludlum Mod-3 (gemeral beta/gamma)	8
6.	Multi-channel Analyzer with Ge-Li	1
7.	Eberline SAC-4 (alpha smear counter)	2
8.	Eberline BC-4 (beta smear counter)	2
9.	Staplex air samplers plus generators	4
10.	T-446 Airbourne Tritium Sampler	1
11.	Topological survey transit	1
12.	Laser theodolite	1
13.	GE 2-way radios plus charger	10
14.	Self reading dosimeters (hi and lo)	50
15.	Film badges	-
16.	Anti-C clothing	-
17.	Protective masks (M-17A2)	20
18.	Administrative supplies	-
19.	Repair tools, maintenance supplies	-

Laboratory, mobile (in trailer), including:

20. Multi-channel analyser
21. Low background smear counter
22. Low background scintillation counter

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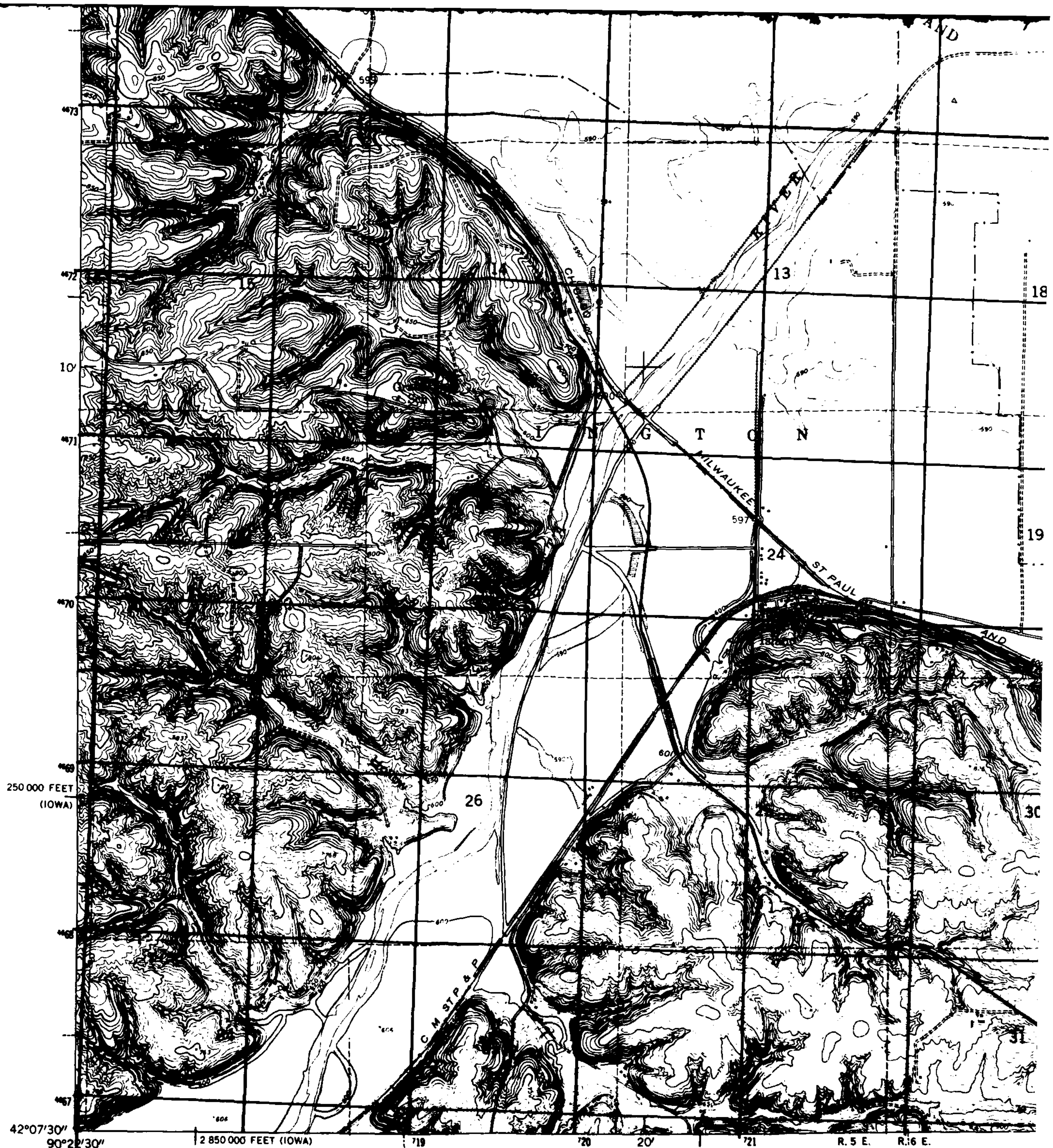
APPENDIX C

Maps and Reproduced Photos

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS

UNITED STATES
DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
GREEN ISLAND QUADRANGLE
IOWA-ILLINOIS
7.5 MINUTE SERIES (TOPOGRAPHIC)
HANOVER
APPLE
RIVER
DEPOT
Mound
QUINCY
JO DAVIESS CO.
CARROLL CO.
WASHINGTON
15
22
33
34



Mapped by the Army Map Service
Published for civil use by the Geological Survey

Control by USGS, USC&GS, and USCE

Topography from aerial photographs by photogrammetric methods
Aerial photographs taken 1952. Field check 1953

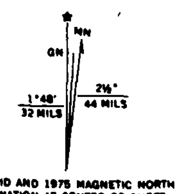
Polyconic projection. 1927 North American datum
10,000-foot grid based on Iowa coordinate system, north zone, and Illinois coordinate system, west zone

Unchecked elevations are shown in brown

Dashed land lines indicate approximate locations

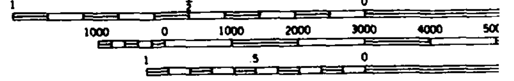
1000-metre Universal Transverse Mercator grid ticks, zone 15, shown in blue

Revisions shown in purple compiled by the Geological S...
...raphs taken 197...



UTM GRID AND 1975 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

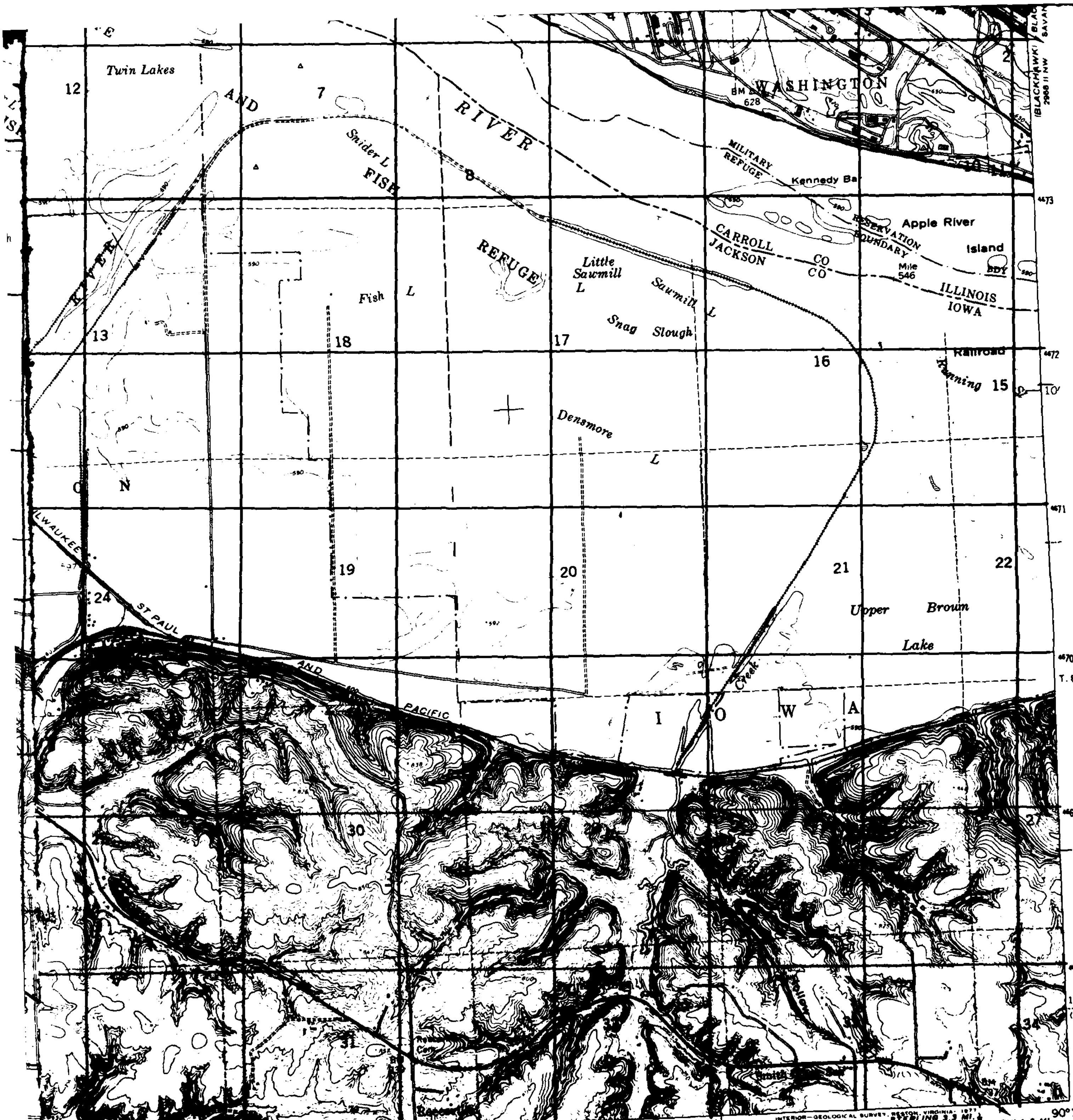
SCALE 1:24 000



CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF

THIS MAP COMPLIES WITH NATIONAL MAP ACCURAC
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 8022
STATE GEOLOGICAL SURVEY, URBANA, ILLINOI
AND IOWA GEOLOGICAL SURVEY, IOWA CITY, IC
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS A

Page 24



ROAD CLASSIFICATION

Heavy-duty — Light-duty

Medium-duty — Unimproved dirt

U. S. Route — State Route

SCALE 1:24 000

1 MILE

7000 FEET

1 KILOMETRE

CONTOUR INTERVAL 10 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

IOWA

QUADRANGLE LOCATION

GREEN ISLAND, IOWA-ILL.
N4207 5-W9015/7 5

1953
PHOTOREVISED 1975
AMS 7968 III NE-SERIES V876

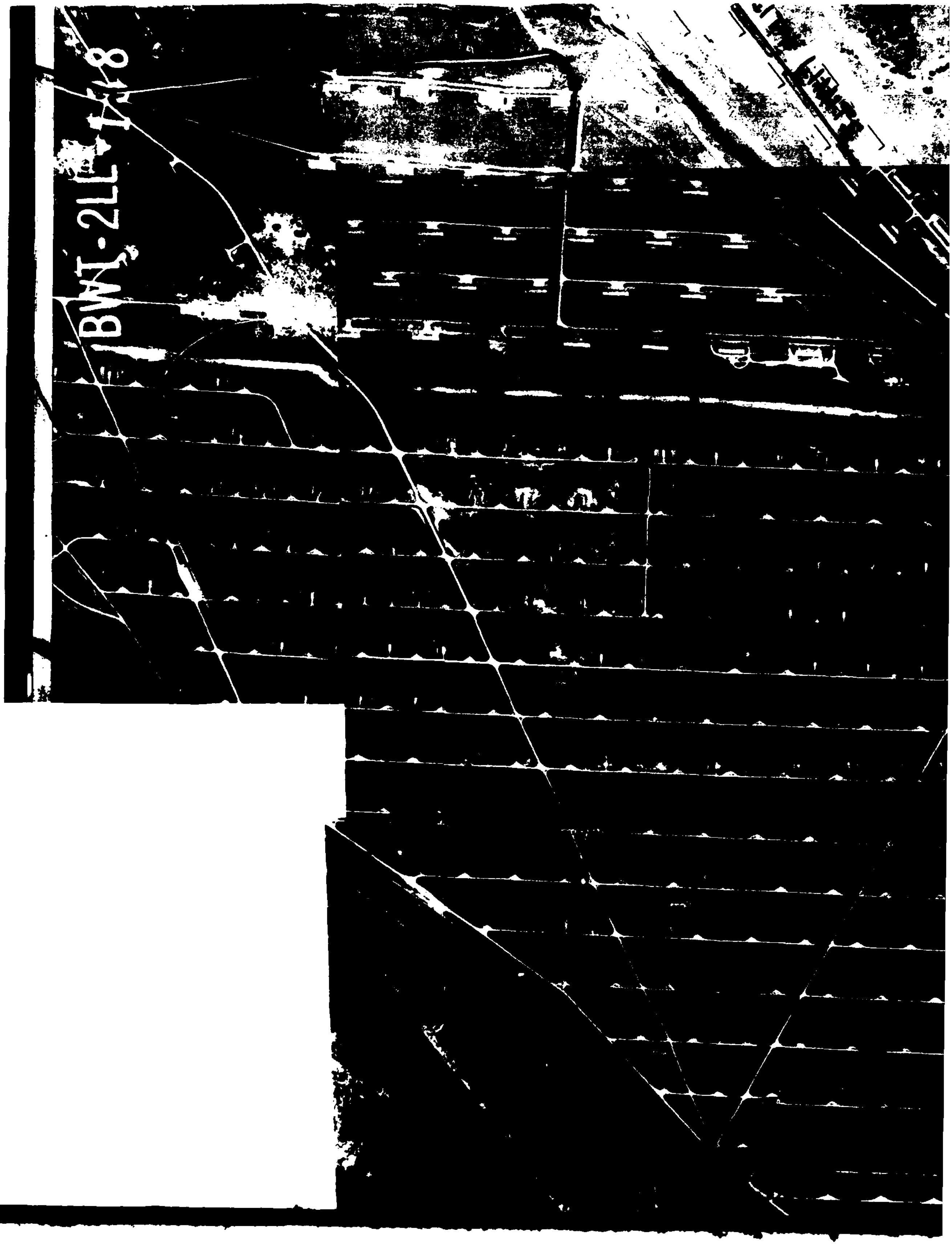
THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
STATE GEOLOGICAL SURVEY, URBANA, ILLINOIS 61801,
AND IOWA GEOLOGICAL SURVEY, IOWA CITY, IOWA 52240
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

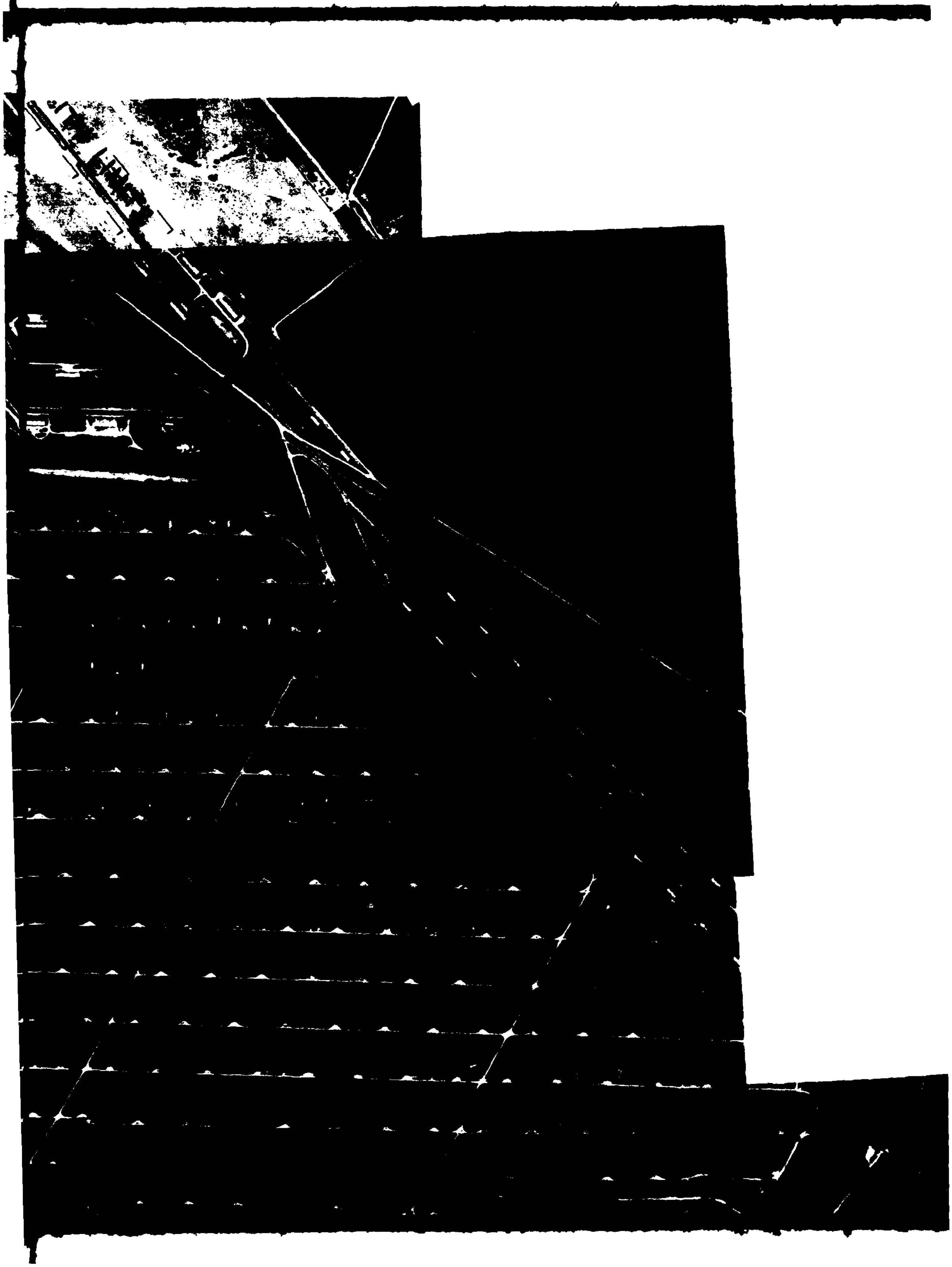
100,000 SQUARE METER DESIGNATION: 15TYS

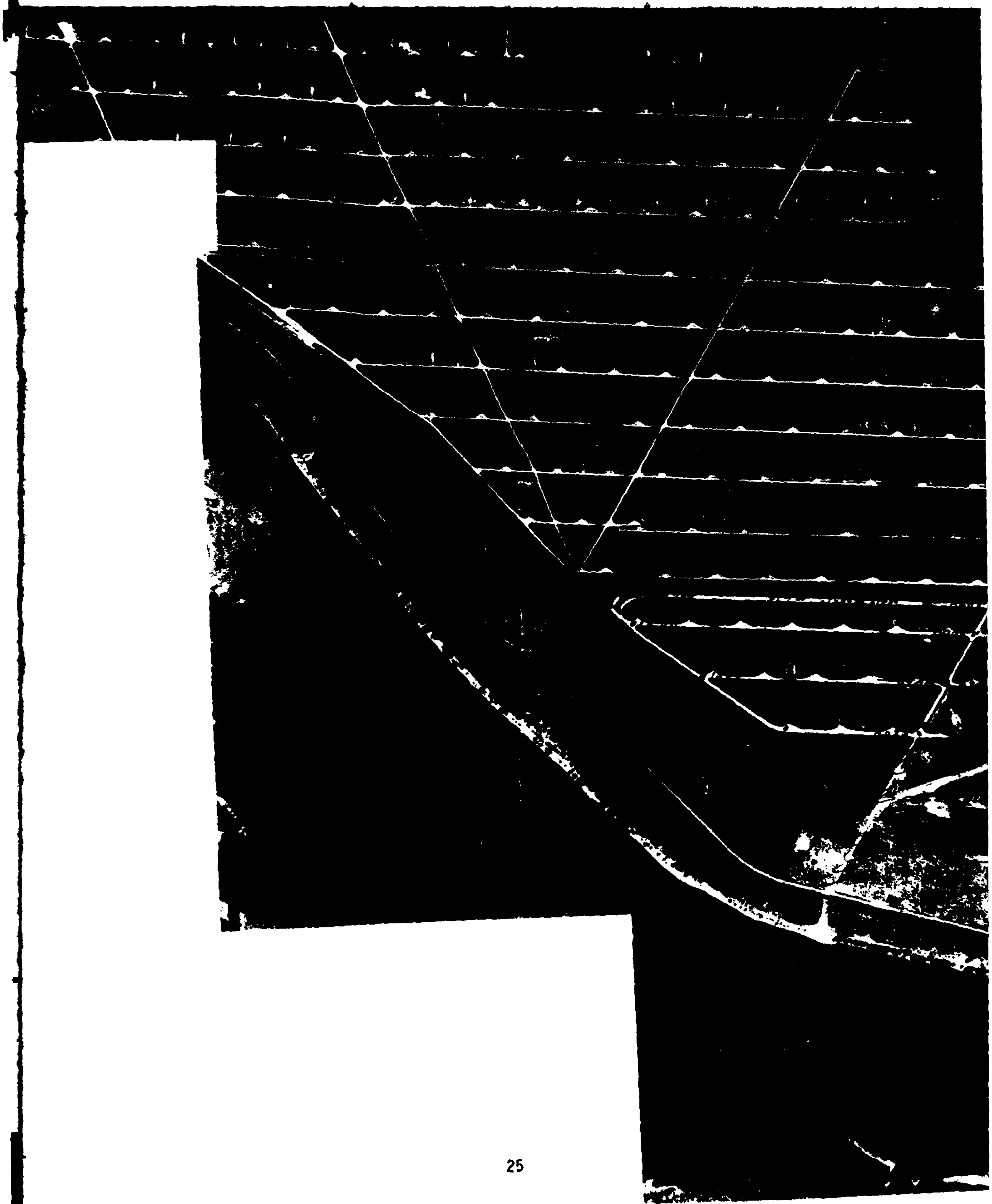
Copies of this provided to: ______________________

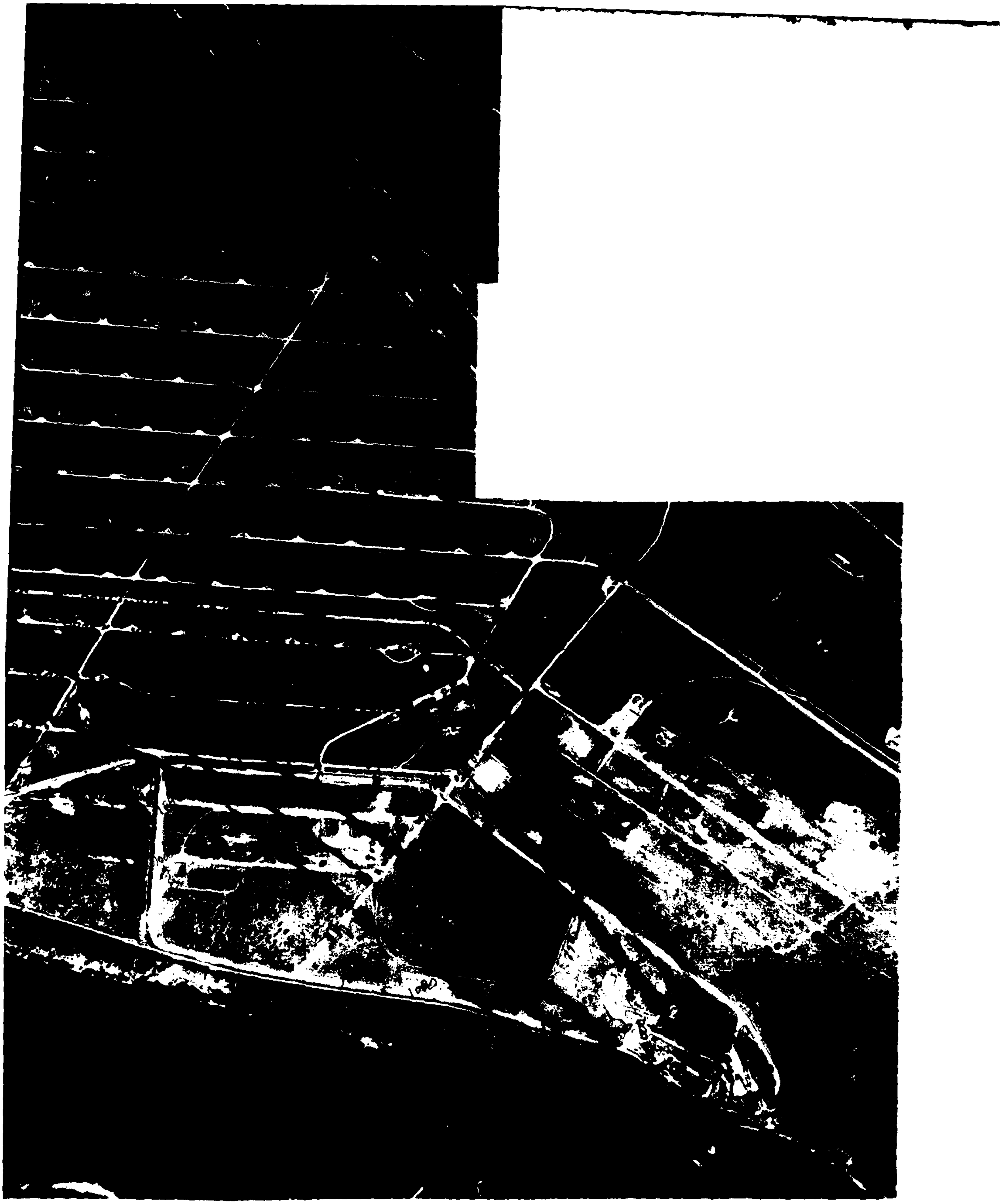
____

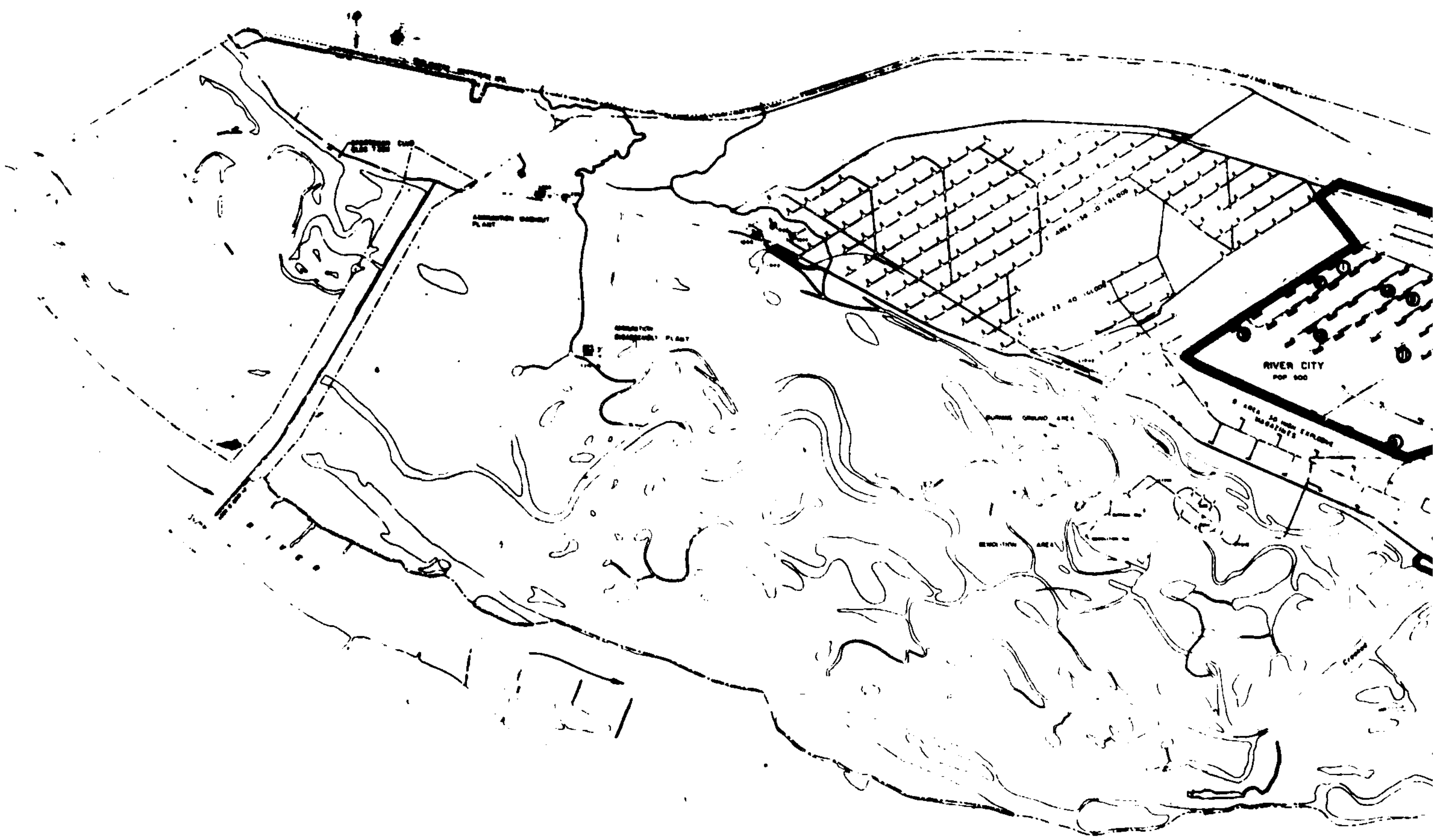
____

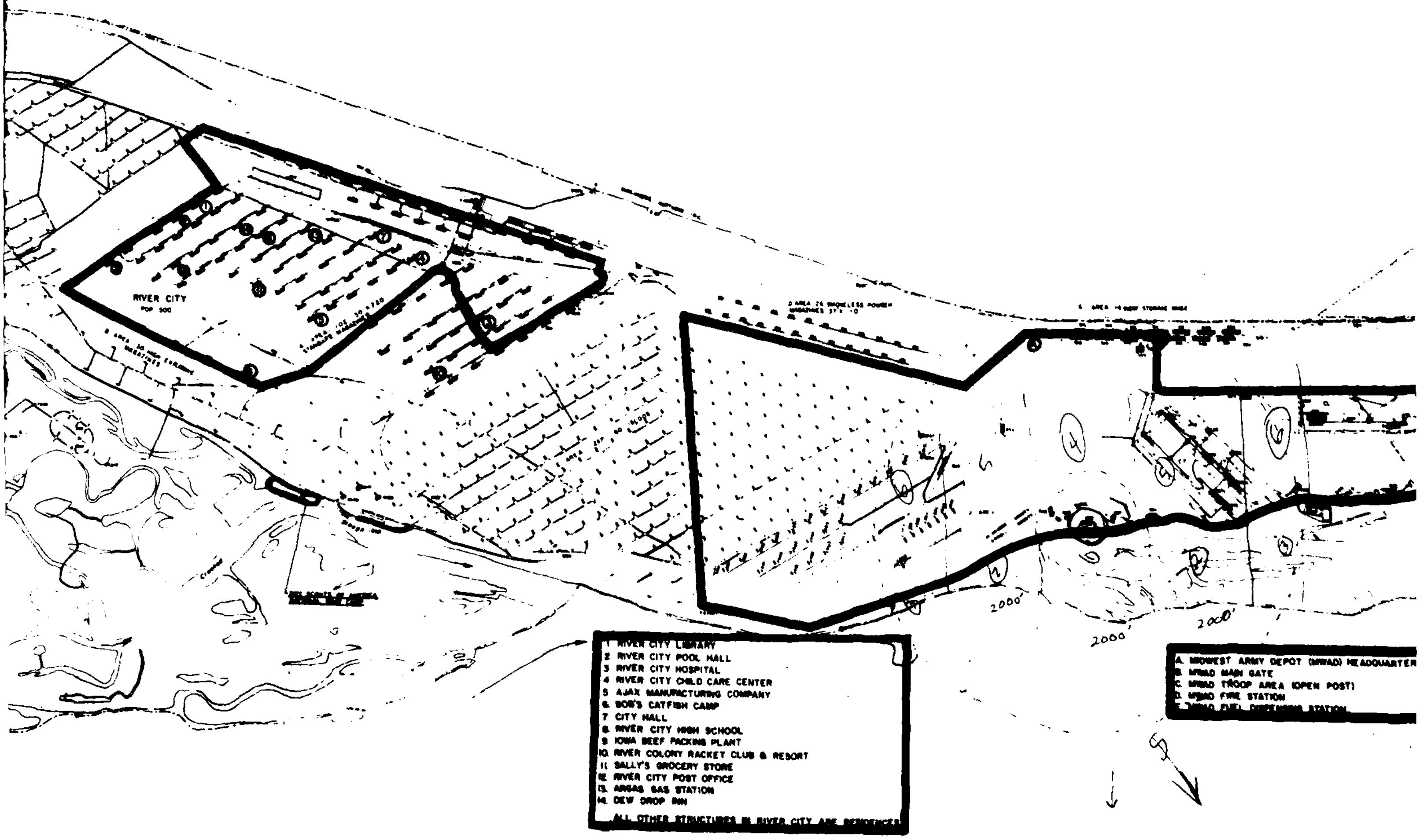


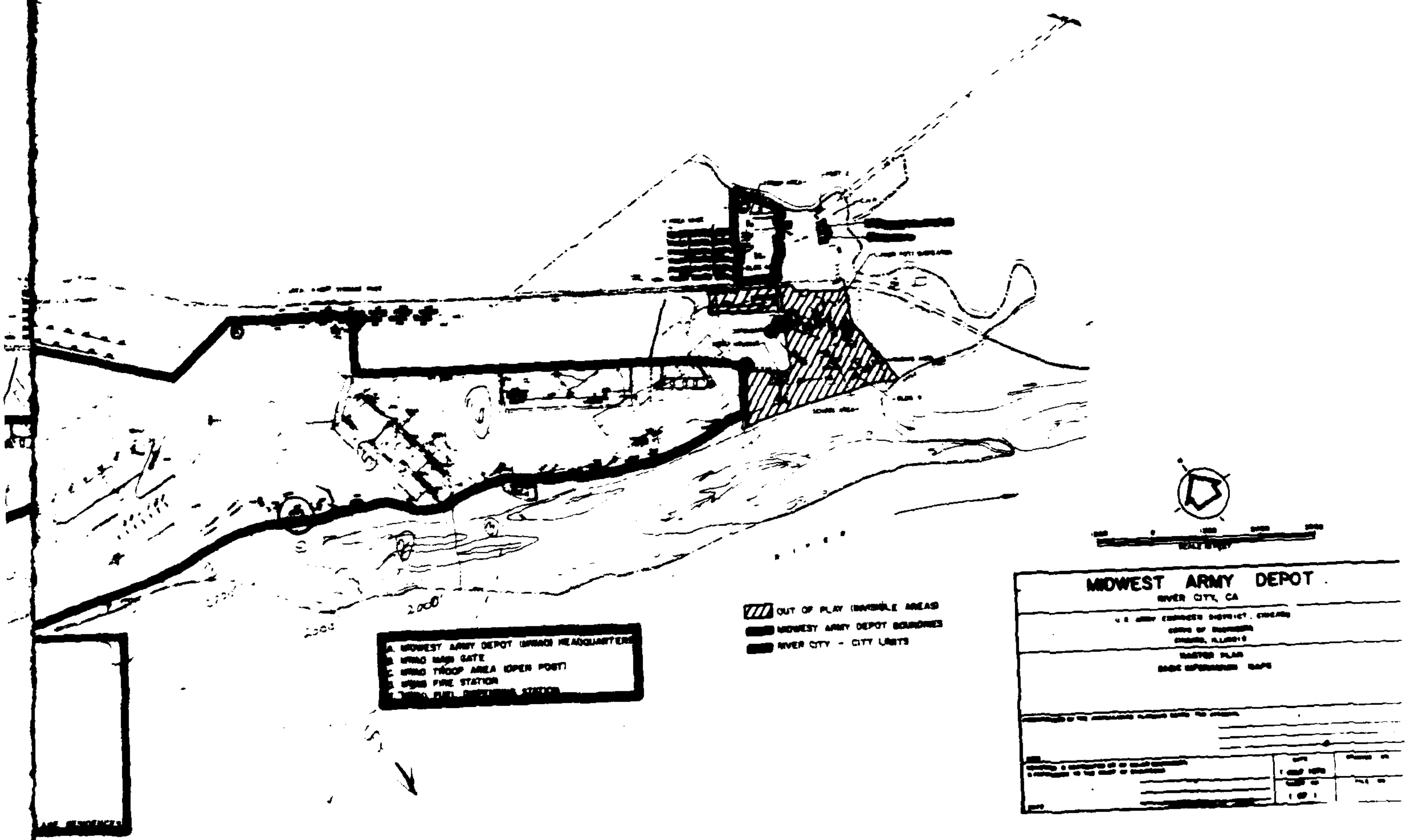







RIVER CITY


RIVER CITY
POP 500
2000'
2000'
2000'
1 RIVER CITY LIBRARY
2 RIVER CITY POOL HALL
3 RIVER CITY HOSPITAL
4 RIVER CITY CHILD CARE CENTER
5 AJAX MANUFACTURING COMPANY
6 BOB'S CATFISH CAMP
7 CITY HALL
8 RIVER CITY HIGH SCHOOL
9 IOWA BEEF PACKING PLANT
10 RIVER COLONY RACKET CLUB & RESORT
11 SALLY'S GROCERY STORE
12 RIVER CITY POST OFFICE
13 ARGAS GAS STATION
14 DEW DROP INN
ALL OTHER STRUCTURES IN RIVER CITY ARE RESIDENCES
A. MIDWEST ARMY DEPOT (MWAD) HEADQUARTER
B. MWAD MAIN GATE
C. MWAD TROOP AREA (OPEN POST)
D. MWAD FIRE STATION


2000'
MIDWEST ARMY DEPOT (MWAD) HEADQUARTERS
MWAD TROOP AREA (OPEN POST)
FIRE STATION
OUT OF PLAY
MIDWEST ARMY DEPOT
RIVER CITY - CITY LIMITS
MIDWEST ARMY DEPOT
RIVER CITY, CA

APPENDIX D

Program FIDLER for the HP 41CX

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TABLE D-1. PROGRAM FIDLER

```
Program FIDLER
     001          LBL FIDLER
     002          ASSAY AGE YR
     003          PROMPT
     004          STO 10
     005          -7.9 E-3
     006          *
     007          E^X
     008          FRAC PU238
     009          PROMPT
     010          *
     011          STO 11
     012          STO 17
     013          FRAC PU239
     014          PROMPT
     015          STO 12
     016          ST+ 17
     017          -1.05 E-4
     018          RCL 10
     019          *
     020          E^X
     021          FRAC PU240
     022          PROMPT
     023          *
     024          STO 13
     025          ST+ 17
     026          -4.81 E-2
     027          RCL 10
     028          *
     029          E^X
     030          FRAC PU241
     031          PROMPT
     032          STO 18
     033          *
     034          STO 14
     035          ST- 18
     036          FRAC PU242
     037          PROMPT
     038          STO 15
     039          ST+ 17
     040          -1.6 E-3
     041          RCL 10
     042          *
     043          E^X
     044          FRAC AM241
     045          PROMPT
     046          *
     047          RCL 18
     048          +
```

Program FIDLER

```
049          STO 16
050          ST+ 17
051          RCL 17
052          ST/ 11
053          ST/ 12
054          ST/ 13
055          ST/ 14
056          ST/ 15
057          ST/ 16
058          AGE AM SRC YR
059          PROMPT
060          -1.6 E-3
061          *
062          E^X
063          AM SRC UCI
064          PROMPT
065          *
066          2.22 E6
067          *
068          0.376
069          *
070          STO 20
071          AM SRC CT RT
072          PROMPT
073          *
074          O.K. I,M WORKIN
075          AVIEW
076          RCL 11
077          0.1055
078          *
079          8.71 E1
080          /
081          STO 22
082          RCL 12
083          0.48
084          *
085          2.41 E4
086          /
087          ST+ 22
088          RCL 13
089          0.1
090          *
091          6.57 E3
092          /
093          ST+ 22
094          RCL 15
095          0.1
096          *
097          3.76 E5
098          /
```

Program FIDLER

```
099    ST+ 22
100    RCL 16
101    0.376
102    *
103    4.33 E2
104    /
105    ST+ 22
106    RCL 22
107    3.32 E9
108    *
109    0.42
110    *
111    RCL 21
112    *
113    RCL 20
114    /
115    1/X
116    SCI 4
117    F=
118    ARCL X
119    AVIEW
120    END
```

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APPENDIX E

Field Message on Rad Waste Disposal

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To: LTC. Anderson

From: RADCON Team Leader

Date/Time: 22AUG85/0900

We request that the following items be ordered in anticipation of requirements generated by the current clean-up activities:

100 each   55-gal drum. DOT spec 17H or 6J.
           (Use: Dirt removed from depot roads and parking lots by the
                  Super Sucker)

25 each   B-25   92 cu. ft. metal boxes
           (Use: Light items to be disposed.)

These containers are authorized for permanent rad waste disposal.

SUGGESTED SOURCE:

Consolidated Container Corporation
(Chicago?), IL

2 tons - Diatometious earth.

SUGGESTED SOURCE: GSA. This is a stock item under the name of "Floor-Dry"

We further request that action be initiat[illegible]ordinate rad waste shipment and burial. Contact should be made with:

Mr. Byron Morris/Mr. Jim Tritz
AMCCOM, Rad Waste Management

av- 398 - 3814

or electronic mail (ARPA-NET) address: kschlagel@stl-1

We can be ~~no~~ of assistence in the Rad Waste actions if you request. RADCON has rad waste experts on site at this time.

John Jacobson
RADCON TEAM Leader, SRFX

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APPENDIX F

RADCON Submissions to After-Action Report

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ARMY RADCON T am/USA Ballistic Research Laboratory
John Jacobson, SRFX Team Leader
298 - 6326

SUBJECT: Reality of Simulation for RADCON Training Purposes

Observation: While the simulation of events was realistic on cold side of hot line, it quite unrealistic on hot side.

a) Discussion:

On cold side, we had to evaluate problems, advise commanders, develop plan of action, organize teams, calibrate equipment, and direct functions to accomplish tasks as required by the On-scene commander.

2) On hot side, the simulated use of equipment served no useful purpose from a training standpoint. The only benefit gained from conducting surveys was training/practice in recording data and correlating that data to specific locations in realistic terrain.

3) Once back to the cold side, the transfer of field data to maps and drawings was meaningful and worthwhile.

b) Recommendation: Future exercises should include the use of actual radiation sources. For example, it would be feasible, and realistic from a detection point of view, to distribute a number of pieces of depleted uranium (DU) over a large area (e.g. 100m x 100m). DU emits both alpha and x-radiation in appropriate energies which would permit the use of actual instruments and procedures, yet is manageable from radiation safety, contamination avoidance, cost and security standpoints.

BJECT: Integration of Alpha and RADCON Teams

) Observation: The integration of the Alpha Team and the transfer responsibility to the RADCON Team, as outlined in FM 3-15, was fected smoothly and efficiently.

) Discussion:

1) Upon arrival of the RADCON Team, we noted that the Alpha Team had aken appropriate initial response actions in setting up a hot line and ontrolling the spread of radioactive contamination by personel exiting he accident site.

2) The action by the NAICO to brief the RADCON Team leaders, transfer esponsibility to the RADCON Team, and integrate the Alpha Team into the ADCON Team led to the rapid establishment of an efficient, capable adiation control element at the accident site.

3) The experiences gained at this excercise, as well as in previous excecises, demonstrates the benefits of joint RADCON-Alpha training and stresses the essentiality of a large cadre of radiation-control experts at an accident site.

b) Recommendation: The training listed in para a3) above should be continued. Furthermore, on-scene commanders must recognize the need for 30-40 radiation control experts at all times to meet the needs generated by a major accident of the sort in this simulation. The RADCON Team can not alone provide sufficient manpower to meet this need without augmentation as effected in this excercise.

SUBJECT: Maps and Aerial Photos

1) Observation: Good quality aerial photos and detailed, CURRENT terrain maps are essential for efficient, accurate RADCON Team functioning.

a) Discussion:

1) The maps, while plentiful, were inaccurate and of inappropriate scale to support planning of survey routes and recording of data.

2) In a real situation, maps would be supplemented by good quality photos taken at the time of the accident response. The lack of such photos also impeded the functions listed in a) above.

3) The availability of ARAC and AMS plots was helpful, but without up-to-date, clear photos, was of limited usefulness.

b) Recommendation: Future exercises should be planned to include these items. But, more importantly, guidance to on-scene commanders, e.g. through the NARP, should emphasize the criticality of such maps and current photos. Multiple copies must be available to all participants: without them, any discussion of the details of the accident and subsequent activities is extremely difficult and necessarily confused.

SUBJECT: RADCON - NAICO Coordination

) Observation: Interaction and coordination between RADCON Team and NAICO was excellent.

) Discussion:

1) RADCON leaders were "read-into" situation by the NAICO, personally, immediately upon arrival. This allowed rapid deployment of RADCON assets and application of expertise.

2) NAICO transferred responsibility for radiation control on site to RADCON Team, as per FM 3-15. This allowed RADCON Team to apply practiced expertise to problem and established clear line of communication between radiation control team and on-scene commander.

3) NAICO himself, or his designated representative, was available at all times in the vacinity of the Hot Line. This maintained the chain of command through which the transfer of situation updates and requests for additional equipment and support were channeled to the appropriate activity on the on-scene commander's staff.

4) An example of such support was the provision of a tent at the Hot Line which was used as a coordination center for all survey data and radiation control activity. The importance of a visually identifiable focal point for this work can not be underestimated.

b) Recommendation: The importance of these actions on the part of the NAICO should be stressed in any documentation on this exercise and in any future training or guidance given to those who might fill that role.

APPENDIX G

RADCON Information Package

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RADCON TEAM (Information Prompter)

Questions to ask prior to or upon arrival at a Nuclear Accident/Incident - Formal Briefing should provide most information.

1. What is the nature of the Accident/ Incident? ______________________

2. Where is the Area Located? ______________________

   Date and Time of Accident/Incident? ______________________

   Is the Accident on Government land? ______________________

   Who made the discovery? ______________________

3. Who is the On-Scene Commander? ______________________

   Where is he located? ______________________

   Telephone Contact? ______________________

   Where is the nearest military installation? ______________________

   Where is the nearest airfield? ______________________

4. Is nuclear criticality an issue? ______________________

   Information regarding weapon assay available? ______________________

   What weapons(s)/nuclear sources (isotopes) were involved? ______________________

   Was there a fire and/or explosion? ______________________

   Was anyone hurt/killed? ______________________

   Has the RAM Team been called? ______________________

   (If yes skip to question(s) 7 next)

5. Has an EOD Team been called? ____________

Have they arrived? Expected when? ____________

Team Point of Contact (Name)? ____________

Telephone contact? ____________

Have they been active in area? ____________

Their findings? ____________

Still EOD Hazard Area? ____________

Radio Exclusion? ____________

6. Has an ALPHA Team been called? ____________

Have they arrived? Expected when? ____________

Team point of contact (Name)? ____________

Have they surveyed the Area? ____________

Their findings? ____________

Have they established a HOT-LINE? ____________

7. Has the RAM Team arrived? ____________

Have victims been monitored prior to removal from vicinity? ____________

If relocated where taken? ____________

8. Is there currently an exclusion or security area established? ____________

Who administers this? ____________

Are there currently any personnel actions in or around the area? ____________

Have private citizens had access to the area? ____________

Have they left the area? ____________

To your knowledge has anything been removed or taken from the area? ____________

9. What were the weather conditions at the time? ______

Prevailing wind direction/speed? ______/______

Any precipitation between then and now? ______

Where is the nearest population center relative to site? ______

______

______

Nearest homes, schools, lakes, rivers, water supplies? ______

______

______

10. What local authorities are involved? ______

______

______

Contacts/Telephone ______

______

What is the nature of their activity? ______

______

______

11. What are the current weather predictions? ______

What is the 24 hour/48 hour weather forecast? ______

______

______

Are access roads available? ______

______

Can road graders, scrapers, oil tanks water tanks, lift trucks- wenches, hardware supplies be obtained locally if necessary? ______________________

____

____

12. Are there currently any political considerations we should know about? ______________________

____

____

The above information obtained from ____________________ (Name), ____________________ (Authority), this ____ day of ________ (Month), 19___, at ______ hours, ______________ (Time Zone)

____
Signed

____
Position

Immediate action taken by the above as follows:

____

____

____

____

____

Copies of this provided to: ______________________

____

____

Form Number	Title
RC-1	Notice of Alert
RC-2	Job Assignment ROSTER
RC-3	Schedule Summary
RC-4	On-Site Entrance
RC-5	Chronological Record of Events
RC-6	Film Badge Record
RC-7	Radioactive Sample Record Form
RC-8	Survey Record (Type A)
RC-9	Survey Record (Type B)
RC-10	Air Sample Record
RC-11	Polar Survey Analysis Form
RC-12	Focal Point Survey Analysis Form
RC-13	Bearing Analysis Form
RC-14	Instrumentation Reference Form
RC-15	Fidler Standardization
RC-16	Pocket Dosimeter Roster

RADCON TEAM LOG

NOTICE OF ALERT

1. General

   (a) Date and Time called ______________________

   (b) Called by ______________________

   (c) Agencies Included ______________________

   Team Only ______________________

   BRL Admin Spt Division ______________________

   APG Emergency Operations Center ______________________

   DARCOM ______________________

   JNACC ______________________

   Chief, VLD ______________________

   (d) Time Team Assembled or Departed ______________________

2. Situation:

3. Recommendations:

OFFICIAL: ______________________
Name, Grade, or Title

Form RC-1
February 1979

RADCON TEAM LOG

JOB ASSIGNMENT ROSTER

Team Composition:

Position	Name and Grade	Notified (Date - Time)
Team Leader --------------	____________	____________
Assistant Team Leader ------	____________	____________
Health Physicist ----------	____________	____________
Decontamination Specialist --	____________	____________
Administrative Assistant----	____________	____________
Monitor ----------------	____________	____________
Monitor ----------------	____________	____________
Equipment Specialist -------	____________	____________
Laboratory Technician ------	____________	____________

(a) To accident site

(b) From accident site

OFFICIAL ____________________
Name, Grade or Title

Form RC-2
February 1979

RADCON TEAM LOG

SCHEDULE SUMMARY

1. Date and Time:

    (a) Alert received ______________________

    (b) Departed APG

        Advance Party ______________________

        Team ______________________

    (c) Arrival at accident site

        Advance Party ______________________

        Team ______________________

    (d) Relieved by NAICO ______________________

    (e) Departed accident site ______________________

    (f) Arrival at APG ______________________

2. Advance Party Composition:

Position	Name and Grade
Team Leader	______________________
Monitor(s)	______________________
	______________________

OFFICIAL ______________________
Name, Grade, or Title

Form RC-3
February 1979

RADCON TEAM LOG

ON-SITE ENTRANCE

1. IDENTIFICATION OF ACCIDENT SITE, WITH PERTINENT DETAILS CONCERNING NATURE OF ACCIDENT.

2. RESPONSIBLE PERSONS AT ACCIDENT SITE:

NAICO: ______________________________
Name, Rank/Organization

MEDICAL OFFICER: ______________________________
Name, Rank/Organization

OTHER( ): ______________________________
Name, Rank/Organization

3. BRIEF OUTLINE OF OPERATION (TO INCLUDE HOURS OF OPERATION, SERVICES RENDERED, EQUIPMENT UTILIZED, AND INJURIES, ETC.)

OFFICIAL ______________________________
Name, Grade or Title

Form RC-4
February 1979

RADCON TEAM LOG

Chronological Record of Events

Date and Time	EVENT

OFFICIAL ____________________
Name, Grade or Title

CONTINUED ON PAGE____________

Form RC-5
February 1979

RADCON TEAM LOG

Film Badge Record

Name and Grade	Date	Film Badge No.

OFFICIAL ____________________
Name, Grade or Title

Form RC-6
February 1979

Date:__________

Time:__________

RADCON TEAM LOG

RADIOACTIVE SAMPLE RECORD FORM

A. IDENTIFICATION OF SAMPLE

1. Sample Number________
2. Type: Air______ Water______ Soil______ Wipe______
   Other (specify)________________
3. Taken by (Name) ________________
4. Taken from (Location) ________________
5. Taken: Date (all)______ Time(all)______(air sample started)
   Date (air)______ Time(air)______Rate (cfm) (air)____
   Date (air)______ Time(air)______Rate (cfm) (air)____
   Date (air)______ Time(air)______Rate (cfm) (air)____
   Date (air)______ Time(air)______(air sample stopped)
6. Volume (cc) (air, water, soil) ________________
7. Area (sq cm) (wipe) ________________

B. FIELD ANALYSIS OF SAMPLE

8. Date______ ______ Time__________Place________
9. Background count (cpm) ________________
10. Beta-gamma count (cpm) Gross________ Net________
11. Alpha count (dpm) Gross________ Net________
12. Contamination level ________________
13. Remarks:

C. LABORATORY ANALYSIS OF SAMPLE

14. Laboratory: Name ________________
    Address ________________
15. Date (all) ____________Time (all)________
    Date (air) ____________Time (air)________
    Date (air) ____________Time (air)________
16. Background count (cpm) ________________
17. Beta-gamma count (cpm) Gross________ Net________
18. Alpha count (dpm) First: Gross________ Net________
    Second: Gross________ Net________
    Third: Gross________ Net________
19. Contamination level ________________
20. Remarks:________________

OFFICIAL________________
Name, Grade or Title

Form RC-7
February 1979

Page ____ of ____ Pages

RADCON TEAM LOG

SURVEY RECORD (TYPE A)

Date____________ Make____________ Sheet No.____

Counter Ser. No. ____________

Monitor__________ **Probe Area ____________ $cm^2 = A$

Time of Reading	Location of Reading	Meter Reading in c/m = R	*Meter Efficiency Factor = E	Pu Concentration $\mu g/m^2 = \frac{(R)x(E)}{(A)x\ 14}$	Remarks

*E = 4 for PAC-3G (Gas Flow)
E = 2 for PAC-1SA

**A = 61 cm^2 for PAC-3G (AN/PDR-54)
A = 59 cm^2 for PAC-1SA (AN/PDR-60)

OFFICIAL ______________________
Name, Grade or Title

Form RC-8(HA)
February 1979

RADCON TEAM LOG

SURVEY RECORD (TYPE B)

DATE ____________________ GRID REFERENCE: ____________________ *1000 μgm/m^2 ∿ ________ c/m

TIME: ____________________ *3500 μgm/m^2 ∿ ________ c/m

INST NO.

LOCATION (See Ref)	FIDLER* (c/m) α	PAC-ISA (c/m) or (mr/hr)	E-500 Series (mr/hr) β / γ	Remarks **

**Always note if soil sample has been taken at location where meter reading was taken

OFFICIAL ______________________________
Name, Grade or Title

Form RC-9(HA)
February 1979

RADCON TEAM LOG

AIR SAMPLE RECORD

I. SAMPLE IDENTIFICATION

A. Location________________________Sample Number__________

II. FIELD INFORMATION

A. Collection Data: Sample Serial Number:____________

	Year	Month	Day	Time	Airflow(CFM)	Total Sample Period
Start Time:	___	___	___	___	________	
Stop Time:	___	___	___	___	________	_____min.

B. Air Volume: $\frac{}{\text{Time(min)}}$ X $\frac{}{\text{Ave, Air Flow (CFM)}}$ = ________(ft^3)

C. Air Volume not known due to: 1.___Motor Failure
2.___Filter Failure 3.___Other

D. Time of Scan ____ ____ ____ ____ ________
Year Month Day Time Time after Collection

E. Estimate not made due to: 1.___Survey meter failure 2.___Other

F. Field Estimate:

Sample $\frac{}{\text{Gross Alpha(CPM)}}$ - $\frac{}{\text{Background(CPM)}}$ = $\frac{\text{Net CPM} \times 10^{-10}}{\text{Air Vol (Ft}^3)}$ = ____ μCi/ml*

Sample: $\frac{}{\text{Gross Beta (mr/hr)}}$ - $\frac{}{\text{Background(mr/hr)}}$ = $\frac{}{\text{Net(mr/hr)}}$

Standard: $\frac{}{\text{Gross Beta(mr/hr)}}$ - $\frac{}{\text{Background(mr/hr)}}$ = $\frac{}{\text{Net(mr/hr)}}$

$$\frac{\frac{}{\text{Net sample}} \times \frac{}{\text{Activity of Standard } (\mu\text{Ci})}}{\frac{}{\text{Net Standard}} \times \frac{}{\text{Air Vol (ft}^3)} \times 2.83 \times 10^{4}} = \mu\text{Ci/ml}$$

G. External Gamma:______________(mr/hr)

III. MPC VALUES OF INTEREST (Air)

Pu-239 Insoluble Restricted Area 4×10^{-11} μCi/ml

Unrestricted Area 1×10^{-12} μCi/ml

If either the identity or the concentration of any radionuclide in a mixture is not known, the limiting values for purposes of Appendix B, CFR 10, Part 20 shall be

a. For purposes of restricted area: 6×10^{-12} μCi/ml
b. For purposes on unrestricted area: 2×10^{-14} μCi/ml

*Applies to 4 inch diameter Whatman 41 filter paper for alpha measurement using a PAC-1SA Radiacmeter.

OFFICIAL________________
Name, Grade or Title

Form RC-10(HA)
February 1979

Page ____ of Pages ____

Date: ____________

RADCON TEAM LOG

POLAR SURVEY ANALYSIS FORM

TRANSIT/ISOCON & ISODOSE LINE DATA SHEET

IDENT OR STAKE NO.	AZ°	U	L	Δ	D	VA°	1000 μg/m² √	3500 μg/m² √	2 mr/h √	True North NOTE:

KEY
AZ - Magnetic Azimuth
U - Upper Stadia Mark
L - Lower Stadia Mark
- Upper Minus Lower Stadia
D - Distance (Range in Feet)
VA - Vertical Angle

Start Time: ________ HRS
Finish Time: ________ HRS

FORM RC-11(HA)
February 1979

OFFICIAL ______________
Name, Grade or Title

RADCON TEAM LOG

FOCAL POINT SURVEY ANALYSIS FORM

METERS: α 1000 $\mu g(Pu)/m^2$ = __________ c/m BKG = __________ c/m

γ 3500 $\mu g(Pu)/m^2$ = __________ c/m

BEARING TO FOCAL POINT (°)	STAKE NUMBER	Pu/γ	DISTANCE TO FOCAL POINT (FT)

DATE ____________________

START TIME: ____________________

FINISH TIME: ____________________

OFFICIAL ________________________
Name, Grade or Title

FORM RC-12(HA)
February 1979

Page_____of_____Pages

Date:_______________

RADCON TEAM LOG
BEARING ANALYSIS FORM

UPWIND BEARING TO GZ* ________

RELATIVE BEARING	BEARING** TO GZ	DISTANCE TO ISOCON/ISODOSE LINES: 1,000 $\mu g\ {}^{239}Pu/m^2$ (ft)	3,500 $\mu g\ {}^{239}Pu/m^2$ (ft)	2mr/hr (ft)
45				
90				
135				
180				
225				
270				
315				
360				

* Angles in degrees, magnetic

** Bearing to GZ = upwind bearing + relative bearing

Reference Point:

Diagram

FORM RC-13(HA)
February 1979

OFFICIAL____________________
Name, Grade or Title

Page ____ of ____ Pages

Date: ______________

RADCON TEAM LOG

INSTRUMENTATION REFERENCE FORM

ALPHA

PRM-5-3 SERIAL NO.__________________ (Electronics)

PROBE: ☐ 5 inch-Be Window: SN________

☐ PG2 Low-E Gamma: SN________

☐ SPA-3 Scintillation: SN ________

CHECK SOURCE (SN.________) PHA__________ NET C/M (Surface Contact)

GROSS ________ NET C/M (Surface Contact)

STANDARDIZATION:

PHA MODE (____KeV Window, HV ______ Channel)

__________Net C/M (1000 μgmPu/M^2 @ 1 ft)

__________Net C/M ( )

BACKGROUND____________________ C/M

ALPHA AN/PDR-60

PAC-1SA(GA): Serial No.______________ (Electronics)

PROBE: ☐ Alpha Probe (59cm^2 Surface Area) AC-3

☐ PG-1 (NaI Scintillation Xtal) SN ______

☐ RASP-1 ( ) SN ______

STANDARDIZATION:

Alpha Probe: Soil 170,000 c/m (1000 μgmPu/M^2 Surface)

Concrete 200,000 c/m (1000 μgmPu/M^2 Surface)

PG-1 Probe: Specify Setup:

BETA/GAMMA

E-500 Series

Check Source:____________ **READING VERIFIED:**__________

WEATHER CONDITIONS:

____

MONITOR(S):______________________ ______________________

SIGN SIGN

OFFICIAL__________________________

Name, Grade or Title

FORM RC-14
February 1979

RADCON TEAM LOG
FIDLER STANDARDIZATION

DATE: ____________________

FIDLER PROBE

STANDARDIZATION

HV Channel No. ____________________
Electronics SN. ____________________
Type: ____________________

Standard No. ____________

PHA Count Rate: __________ c/m Surface Contact
Gross Count Rate: __________ c/m Surface Contact

Calibration:* ______ Inch Xtal Probe No. ______
______ cm from surface plane

Count Rate (c/m)	Radial Distance (cm)
______	0
______	5
______	10
______	15
______	20
______	25
______	30
______	35
______	40
______	45
______	50
______	55

Background: __________ c/m

Certified Standard
No. ____________________

Type: ____________________

Activity: ________________ **ntps(Q_o), or
Activity: ________________ μCi
Date: ____________________

Current Activity (See Reverse Side):

Q = ________________ **ntps, or

= ________ μCi

Energy: __________ keV

Abundance: __________ Percent

A_b = ______ %/100= ___0.___

Half-Life: ____________ Years, or
____________ Days, or
____________ minutes, or
____________ seconds

$t_{lapse} \approx$ ____________ Seconds

Continued on reverse Side

*Reference: FM 3-15 Insert article by J.F. Tinney
**Consider only if micro-curie strength is unknown.

FORM RC-15
February 1979

OFFICIAL ____________________
Name, Grade or Title

DATE________________

RADCON TEAM LOG

POCKET DOSIMETER ROSTER

Name	Dosimeter Range	Serial No.	Reading Initial	Reading Final	Period (HRS)

FORM RC-16
February 1979

OFFICIAL________________
Name, Grade or Title

38.45

U S ARMY BALLISTIC RESEARCH LABORATORY
ABERDEEN PROVING GROUND, MARYLAND 21005

DRDAR-BLV 21 March 1979

SUBJECT: NAIC Radio Frequencies

Commander
US Army Technical Escort Unit (TEU)
Aberdeen Proving Ground, MD 21010

1. The US Army RADCON Team, a mission of this Laboratory per AR 50-5 and DARCOM Sup 1, is planning the acquisition of new transceivers. At present we are operating on CB using individuals' licenses, but have been advised by the FCC that this is not appropriate.

2. Informal discussion with Signal personnel indicates that assignment of a military frequency will be excessively time consuming. Suggestion was made that we share the 36.71 and 36.89 channels assigned to TEU.

3. Our only use of radios is at the scene of a NAI, or during training exercises in Nevada, where monitoring teams keep in contact with control, at low power. It is felt that there would be no conflict with existing TEU operations, and that a direct radio link with TEU at a NAI site would be mutually beneficial, due to your recently assigned NAIC responsibilities.

4. Your comment is requested. Our POC is Mr. Joseph C. Maloney, 671-3027.

FOR THE COMMANDER:

David L. Rigotti

DAVID L. RIGOTTI
Chief, Radiation Engineering Branch
Vulnerability/Lethality Division

SARAR-CF (21 Mar 79) 1st Ind
SUBJECT: NAIC Radio Frequencies

US Army Technical Escort Unit, Aberdeen Proving Ground, MD 21010
30 March 1979

TO: Commander, US Army Armament Research and Development Command,
ATTN: DRDAR-BLV/Mr. Maloney, Aberdeen Proving Ground, MD 21005

1. Your request for the RADCON Team to share TEU assigned frequencies is concurred in by this unit contingent upon the following:

a. Every use of subject frequencies in or around any TEU operation, especially Edgewood Area, APG, MD, must be expressly approved by the Commander, TEU, on a case-by-case basis, except as outlined in para d below.

b. The number of your operating stations shall be limited to 12.

c. All use of TEU frequencies shall be IAW FCC regulations, any violations of which shall be cause for this unit to remove approval for RADCON Team use of TEU assigned frequencies.

d. Concurrent or sole use of subject frequencies in or around actual or training NAIC sites is permitted. However, if TEU is present TEU will operate the net control station.

2. If the above conditions are acceptable, this indorsement shall serve as this unit's written approval for you to proceed toward eventual use of TEU assigned frequencies. Satisfaction of all administrative requirements to permit the RADCON Team use of the frequencies is the responsibility of BRL.

3. POC for this unit is CPT Cramblett, 671-4381/3601.

WILLIE D. GREENE
LTC, CmlC
Commanding

2

Radio Communications SOP

1. The following shall be performed at the briefing area prior to entering contaminated area

a. Insert batteries into each radio and perform battery check.

b. Team leader chooses primary and secondary radio channels.

c. Team leader assigns call sign for each radio.

d. Enclose radio except for antenna in plastic bag if radio is to be used inside contaminated area

e. Perform receiving and transmitting check of each radio.

2. Battery Insertion and Battery Check

a. Loosen battery compartment screw which is located at bottom of radio, open compartment, and insert 10 'AA' batteries (1.5v) with polarity as shown on the case label.

b. Turn power "on" by rotating volume control knob clockwise.

c. Set channel selector to "B".

d. Read battery condition on the S/RF/BATT meter. Replace batteries if reading is not in white area.

3. Receiving Instructions

a. Extend antenna fully and keep in a vertical position.

b. Turn squelch control knob completely counterclockwise.

c. Turn power on by rotating volume control knob clockwise.

d. Adjust squelch by rotating squelch control knob clockwise to the point where any background noise just stops.

e. Adjust volume for a suitable listening level.

4. Transmitting Instructions

a. Extend antenna fully and keep in a vertical position.

b. Set power switch to LO when transmitting a short distance.

c. Turn power "on" by rotating volume control knob clockwise.

d. Set channel selector to designated channel.

e. To transmit, press talk button which is located on side of radio, Speak slowly and clearly in a normal voice 2" to 3" from the built-in microphone.

f. To receive, release the talk button.

5. Special Instructions

When radios do not work or are not allowed, one man from each team will have to be used to relay messages from the hot zone to the edge of the hot line and then the hot line monitor will carry the message to the operations center.

If insufficient personnel are available, hand signals will have to be used to the extent possible.

The INFERENCE of Pu Contamination Density via the BARK

1. *PURPOSE*

The purpose of this ~~little~~ treatise is to explain the inference of plutonium contamination, as might be expected in case of an accident involving the burning of a plutonium-containing munition, from the low-energy gamma (x-ray) measurements that can be made with the FIDLER probe.

2. *BACKGROUND*

The need to use indirect measurement techniques for the quantitative measurement of plutonium is manifest to anyone who has tried to directly detect the eminations from plutonium itself. Basically, 239Pu, the most common isotope of Pu, is an alpha emitter with radiations in the range of 5 MeV. Unfortunately, the energy loss per length of path of a 5 MeV or lower alpha particle passing through any material is very high. (A 5 MeV alpha has a range of about 3.5 cm in air and 0.0025 cm in aluminum, whereas an equally energetic gamma has a half length greater than 9 cm in aluminum.) As a result, alpha detectors must have extremely thin windows to allow the particles to enter the detection region: This results in alpha detectors being extremely fragile, and notoriously impractical for field exercises.

More seriously, the extremely short range of alpha particles through any material makes alpha measurement prohibitively sensitive to shielding matter. Thus, a minute amount of dust over a contaminated area will dramatically alter an alpha radiation field and consequently the perceived level of contamination.

As a result, the radiation survey community has developed indirect means of inferring the level of Pu contamination. Basically, these methods involve measuring radiations from other isotopes which are present with 239Pu. A knowledge of the contamination level of these isotopes can then be scaled to determine the Pu level. Specifically, the Broken Arrow Response Kit (BARK) contains a Field Instrument for the Detection of Low Energy Radiation (FIDLER) detector probe which was designed to be particularly efficient in the detection of low energy gamma radiation (x-rays). Using this probe, it is practical to make quantitative measurements of the amount of 17 KeV and 60 KeV gamma rays produced by 241Am, a companion to weapon grade plutonium.

This treatise provides the technique and factors needed to relate a given COUNT RATE produced by the detection of 17 or 60 KeV gamma rays to the associated plutonium contamination.

3. *Specific Activity of Pu and 241Am*

Plutonium contamination is a mixture of 238Pu, 239Pu, 240Pu, 241Pu, 242Pu, and 241Am, where the 241Am is a daughter of the beta decay of 241Pu.

$$^{241}Pu \longrightarrow \beta^{-} + {}^{241}Am$$

For this discussion, we assume that the mxture is isotropic in the contaminated area. We also assume that we can ignore the small mass difference between the various isotopes and use an average atomic mass. Referring to the hypothetical assay shown in Table 1, we take that mass to be 239.3.

TABLE 1. A Typical Assay of Plutonium Isotopes

Isotope	%by mass(1972)	%by mass(1982)	1/2-life(yrs.)
238Pu	0.	0.	87.74
239Pu	81.7	81.7	24,300.
240Pu	5.6	5.6	6,600.
241Pu	1.6	0.95	13.2
242Pu	0.	0.	380,000.
241Am	11.1	11.59	470.

The activity eminating from mass of isotope j can be calculated from:

$$m_j \cdot \frac{\text{No. of atoms}}{\text{mass}} \cdot \frac{\text{Activity}}{\text{atom}}$$

In turn, the number of atoms per mass can be found from $\mathring{N}$, Avagadro's number (the number of atoms per gram-mole) and the average mass:

$$\frac{\text{N. of atoms}}{\text{mass}} = \mathring{N}/239.3 = 2.52 \times 10^{21} \text{ atoms/gr.}$$

The relationship between the activity per atom and the half-life ($t_{1/2}$) is found from the Law of Radiative Decay:

$$dN/dt = -\lambda N$$

with solution $\quad N = N_0 e^{-\lambda t}$

$$\frac{\text{Activity}}{\text{atom}} = -\frac{dN/dt}{N} = \lambda = 0.693/t_{1/2}$$

Putting this together, the total activity (disintegrations/time) is given by:

$$\text{TOTAL ACTIVITY}\left[\frac{\text{disint}}{\text{yr}}\right] = \sum_j m_j[\text{gr}] \cdot \frac{2.52 \times 10^{21}}{[\text{gr}]} \cdot \frac{0.693}{t_{1/2\,j}[\text{yr}]}$$

where m_j is the mass and $t_{1/2\,j}$ is the half-life of isotope j. (Here, we introduce the use of [ ] to indicate the dimensionality/units of the various quantities.) Since we are usually interested in the contamination in terms of areal density (ug~/m**2), we can rearrange the Total Activity equation as follows. Let the total mass be expressed in terms of the fractional weights f_j of the isotopes in the mixture as:

$$\text{TOTAL MASS}[\text{gr}] = \sum_j m_j[\text{gr}] = M \cdot \sum_j f_j$$

The Total Activity per Area can be expressed as:

$$\frac{\text{TOTAL ACTIVITY}}{\text{AREA}}\left[\frac{\frac{\text{disint.}}{\text{yr}}}{m^2}\right] = \frac{M[\text{gr}]}{\text{Area}[m^2]} \times \sum_j f_j \cdot 2.52\times10^{21} \cdot \frac{0.693}{t_{1/2\,j}[\text{yr}]}$$

Finally, converting to micrograms and minutes and using C for the contamination density, we have:

$$\frac{\text{TOTAL ACTIVITY}}{\text{AREA}}\left[\frac{\frac{\text{disint}}{\text{min}}}{m^2}\right] = C\left[\frac{\mu\text{gr}}{m^2}\right] \cdot \sum_j 3.32\times10^{9} \cdot \frac{f_j}{t_{1/2\,j}[\text{yr}]}$$

4. *Relating the Contamination per Area to FIDLER Reading*

The final, important chapter of this treatise is to relate the FIDLER readings - which are in counts per minute caused by 17 or 60 KeV gammas to density of Pu per area of ground. To do this, it is essential to know the number of 17 KeV (or 60 KeV) gammas per disintegration for the various isotopes. This factor is listed in Table 2.

TABLE 2. Selected Radioactivity Data on Pu - Am Isotopes

Isotope	Half-life (yrs)	Spec. Activity (dis/min/ugr)	17KeV Gammas per disint.
238Pu	8.77e1	3.78e7	0.1055
239Pu	2.41e4	1.38e5	0.048
240Pu	6.57e3	5.05e5	0.1
241Pu	1.44e1	2.31e8	0.0
242Pu	3.76e5	8.83e3	0.1
241Am	4.33e2	7.67e6	0.376

Now, the reading on a FIDLER depends upon 1) the activity density (contamination per area), 2) the number of gammas per disintegration, 3) the geometry of the probe relative to the ground, and 4) the efficiency of the probe in detecting gammas which hit the active detector area. Symbolically, that can be written:

$$\text{Count Rate} = \frac{\text{Total Activity}}{\text{Area}} \cdot \text{Branching Ratio} \cdot \text{Geometrical Factor} \cdot \text{Probe Efficiency}$$

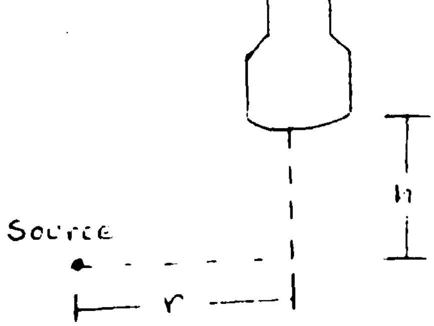
$$\left[\frac{\text{cts}}{\text{min}}\right] = \left[\frac{\frac{\text{disint}}{\text{min}}}{m^2}\right] \cdot \left[\frac{\gamma_{\text{emit}}}{\text{disint}}\right] \cdot \left[\frac{\gamma_{\text{hit probe}}}{\gamma_{\text{emit}}/m^2}\right] \cdot \left[\frac{\text{cts}}{\gamma_{\text{hit probe}}}\right]$$

where one must recall that the all references to gammas refer only to those in the energy range of interest (17 KeV or 60 KeV). The first two terms, Activity Density and Branching Ratio (gammas/disintegration, were discussed above. It remains to discuss the final two factors, the Geometrical factor and the Detector Efficiency.

It turns out that the standardization technique used by the RADCON team does not determine the Geometrical and Efficiency factors independently. Rather, it is most convenient to use a hybrid technique to accurately and field-expediently solve for the two terms together. To help see the derivation, the dimensional analysis begun above will be carried forth here.

First, in the laboratory, we measure a constant geometrical hybrid constant K(h).

$$K(h) = 2\pi \int_0^\infty \frac{dr \cdot r \cdot X(r,h)}{X(0,h)}$$



X(r,h) is the count rate from a source radially out a distance r from the probe, which is at a height h above the monitored surface. K(h) is the relationship between a point source below the probe (which is used for calibration) and a uniformly distributed source over the ground. The dimensionality of K(h) is:

$$K(h) = \left[\frac{\gamma_{hit} \cdot \epsilon_{ff} \cdot m^2}{\gamma_{o_{hit}} \cdot \epsilon_{ff}} \right]$$

where $\gamma_{o_{hit}}$ refers to γ_{hit} emitted at r = 0.

K(h) was measured by moving a source out radially out from under the FIDLER probe, taking measurements at selected points, and performing the indicated mathematics. If we symbolically divide top and bottom of the above expression by γ_{emit} and rearrange we get:

$$K(h) = \left[\frac{\gamma_{hit}}{\gamma_{emit}/m^2} \right] \Big/ \left[\frac{\gamma_{o\,hit}}{\gamma_{emit}} \right]$$

Independently, immediately before going out into the field, a known source, Q_{CALIB} , is placed below the probe and the resulting count rate, X_{CALIB} , is recorded. Dimensionally, we can write:

$$\frac{X_{CALIB}}{Q_{CALIB}} = \left[\frac{cts/min}{\gamma_{emit}/min} \right]$$

Of course, it is assumed that all meter readings have been background-corrected. Now, we multiply K(h) by the X/Q ratio to get:

$$K(h)\cdot\frac{X_{CALIB}}{Q_{CALIB}} = \frac{\left[\dfrac{\gamma_{hit}}{\gamma_{emit}/m^2}\right]}{\left[\dfrac{\gamma_{hit}}{\gamma_{emit}}\right]} \times \left[\frac{cts/min}{\gamma_{emit}/min}\right] = \left[\frac{\gamma_{hit}}{\gamma_{emit}/m^2}\right]\times\left[\frac{cts}{\gamma_{hit}}\right]$$

Comparing to the count rate equation, we see that the K(h), X/Q product does equal the last two terms in the expression.

5. *The ULTIMATE Relationship*

All of the above can now be put into the count rate equation:

$$\text{COUNT RATE}\left[\frac{cts}{min}\right] = \left[C\left[\frac{\mu gr}{m^2}\right]\cdot\sum_j f_j\cdot\frac{3.32\times10^9}{t_{1/2_j}\,[yr]}\right]\times\left[\text{BRANCHING RATIO}\right]_j\times K(h)\times\frac{X_{CALIB}}{Q_{CALIB}}$$

If we now solve for C, the desired contamination density, we have the desired, ULTIMATELY useful relationship between Pu contamination and FIDLER count rate from measureable gammas:

$$C\left[\frac{\mu gr}{m^2}\right] = \frac{\text{COUNT RATE}\,[cts/min]}{\sum_j f_j\times\dfrac{3.32\times10^9}{t_{1/2_j}\,[yr]}\times\text{BRANCHING RATIO}_j\times K(h)\times\dfrac{X_{CALIB}}{Q_{CALIB}}}$$

$$= F\times\text{COUNT RATE}\,[cts/min]$$

where the calibration factor, F, is the inverse of the above denominator. For h = 30cm., the factor K(h) = 0.40 m**2. The branching ratio and half-lives are also known. Therefore, it is only necessary to determine the assay at some point in time, which allows computing the s, and to make the field measurement X of the known source, Q.

To aid the calculation of F, a program has been written for the HP-41c hand calculator. Called FIDLER, it prompts for years since assay, (decimal) fraction by weight of each isotope, activity and time since assay of a 241Am field calibration source (Q) and the field calibration count rate, X.

Contamination Limits

Reference: Technical Manual - Plutonium Contamination Standards
22 May 1968

The referenced document which was published under the authority of the Secretaries of the Army, Navy, and Air Force; Director, Defense Atomic Support Agency; and the Atomic Energy Commission states that areas contaminated to levels greater than 1000 $\mu gPu/m^2$ shall be decontaminated until surface readings are reduced to less than 1000 $\mu g/m^2$ where such reduction is possible and is consistent with reasonable cost and effort. This guideline was derived from various tests and field experience involving scattering of Plutonium oxide.

A second manual entitled "Manual for Nuclear Accident Response and Team Operations" published by Nuclear Training Directorate, Field Command, DASA, dated 1 Nov 1968 defines an area with a residual contamination level of 3,500 $\mu g/m^2$ as a chronic-hazard area apparently because of the ease with which this level of contamination can become resuspended.

The latter manual also discusses the 10 mr/hr line for β-γ associated with a weapon accident. The manual points out that β-γ will be present only if any nuclear fission occurred and then the decay will be so rapid that only the 10 mr/hr line should be marked to avoid any over-exposure. However, since the RADCON team has had its mission expanded where we may encounter β-γ from sources other than devices that may have had some nuclear fission we should look for that level that is considered to be a radiation area. This level happens to be 2 mr/hr according to OCCS (Bradley).

RADCON Dress-out

Purpose: to define the most practical and useful procedures to follow such that the dress-out of the Radcon Team is performed in the shortest time period possible but with a thoroughness that will assure all team members maximum radiological protection.

Reference: (1) Field Manual, FM-15, Nuclear Accident Contamination Control, Nov 1975.

(2) Field Report, Pre-NUWAX Exercise, Radcon Team, BRL, Aberdeen Proving Grd, MD, Sept 1978.

CAUTION

It must be remembered that emergencies are not restricted to temperate zones and may occur in desert, jungle, or frozen wastelands. In any case, the Radcon Team leader must assure himself that the team will be able to function without undue anguish of body or mind. It is expected that a "normal" emergency would probably occur in temperate-type zones and consequently this procedure reflects that decision.

Background.

At the site of radiological emergencies it is mandatory that all Radcon team members be protected from nuclear contamination by suitable dress donned in a manner to

- assure protection,
- minimize the spread of contamination,
- reduce the time element.

In most cases, reduction of the time element involved in dress-out is a prime consideration in controlling the extent of contamination at the disaster site. These procedures reflect the requirements of Ref (1) and the practical experience gained at a recent remote test-site exercise (Ref 2).

Protective Equipment.

The minimum protective clothing requirement for each member of the Radcon team consists of the following items:

- boots, rubber, calf-high (1 pair)
- bags, plastic, foot-size (2 ea)
- coveralls, industrial, cotton (2 pair)[1]
- gloves, rubber, surgeons (1 pair)
- gloves, cotton cloth, work-type (1 pair)
- hood, cotton cloth (1 ea)
- mask CBR, M-17 or equal (1 ea)
- armband, Radcon team (1 ea)
- masking tape, paper, 7.6 cm wide (1 roll)

These minimum requirements must be met each time a team member crosses the HOT LINE for as long as the team is employed by the On-Site-Commander. The Radcon Team leader with the consent of the health physicist has the option to substitute equivalent items as needed.

Buddy-system.

A buddy-system should be employed to minimize dress-out time and assure that each group of team members is equivalently dressed. One such grouping of the minimum 10-man Radcon team (see FM-3-15) could be:

- Team Leader and Health Physicist
- Monitors Team A
- Monitors Team B
- Survey Team
- HOT LINE Supervisor and Lab Technician/Equip Specialist

Each buddy should help his partner dress-out, apply tape, and should give a final examination before permitting his partner to cross the HOT LINE.

Tape Sealing.

Paper masking tape may be used to seal all openings in coveralls and for sealing closed sleeves and pant legs. Tape widths of 5.0 to 7.6 cm are most practical. A large flap of tape should be doubled-over and within easy reach of gloved-hands at the end of a taping enclose to facilitate removal when the team member is returning and disrobing at the HOT LINE. The flap is most useful if it is about 2.5 or 3 cm long.

1. One pair of coveralls may be the drawstring-type cotton coverall.

Coveralls.

Two pair of coveralls are normally required and both pair should be several sizes larger than the dress-suit-size of the team member to assure first, enough length in sleeves and pant legs to permit taping but not restrict movement and secondly, enough body size to give ease in bending, walking, climbing, stretching, etc.

The inside coveralls are donned first and need not have taped openings. The outside coveralls must have all pocket and body openings closed for those types of coveralls closing with buttons, tabs, etc. For drawstring type coveralls, each opening should be drawn up snuggly and then taped closed. Each leg and sleeve must be taped closed to the boot or glove as the case may be.

Boots, Rubber.

It is assumed that each team member will be wearing his own shoes and should place a plastic bag over each shoe, and tape the bag to his leg to prevent the bag from being removed with the rubber boot. The plastic bag should also be inside the inside coveralls. The plastic bag provides protection and eases the slipping on of the rubber boots.

The rubber boots should be calf-length, with the inside coveralls bloused and taped to the upper most outside of the boot. The legs of the outside coverall should also be taped to the boots but slightly below the taping of the inside coverall.

Gloves.

The surgeon's type gloves should be slipped on snuggly, fed under the sleeves of the inside coveralls, and then taped to the ends of the sleeves.

The outside pair of gloves may be either the heavy industrial work-type cotton gloves or the softer-type cotton glove. In either case, the outside glove should be fitted inside the outside coverall sleeve and taped to the edge of the sleeve. (Leather gloves are also available for use in handling heavy or sharp objects).

Hood, Cotton Cloth.

After the CBR M-17 mask has been fitted, a cotton cloth hood should be donned and positioned around the mask and flared-out over the shoulders. Firstly, the hood should be taped to the mask behind the lens and under the chin. Secondly, the hood should be taped to the shoulders, back and front of the outside coveralls. It is best if the head is tilted to the side opposite each taping to assure as much freedom of head movement as possible when the taping is completed. Thirdly, the opening in the hood under the chin should be taped closed. (For comfort a surgeon's cap may be worn under the protective mask).

Identification.

It is essential that each team member have his armband displayed on his left arm and his last name taped to the front and back of the outside coveralls.

SOP FOR HOT LINE OPERATIONS

Purpose: The purpose of this SOP is to present guidelines for activities at the Hot Line when survey teams enter and return from the contaminated area.

Reference: Field Manual, FM 3-15, Nuclear Accident Contamination Control, Nov 1975.

1. Establishment of Hot Line.

The Hot Line by definition is that line which separates the contaminated area from the contamination reduction area. In the event of accident, according to FM 3-15, the Hot LIne would have been established by the time the RADCON team arrives on the site. If this has not been done the following steps should be taken to establish the Hot Line.

a. Team dresses out in full protective clothing according to procedures outlined under the Dress Out SOP at the control point. The control point would have been established upwind of the accident site.

b. An advance party which will include the team leader, and two additional team members, will proceed from the control point toward the accident site. Their equipment will include an air sampler, a fidler, an E520, a two-way radio, and a red marking stake.

c. The point at which the radiation level reaches 3σ of background shall be marked with the stake. This will represent the location of the Hot Line.

d. Remaining team members dressed out in protective clothing snall be summoned by radio.

e. An exclusion barrier shall be marked by engineer tape a minimum of 100 feet to the left and right of the stake marker and approximately perpendicular to the wind direction. The tape shall be staked at a height of approximately one meter whenever possible. However, if no equipment is available to support the engineer tape, it is sufficient to lay the tape along the ground to mark the Hot Line.

2. <u>Equipment Set-Up</u>

a. Air sampler will be set up adjacent to the Hot Line as shown in Figure 1.

b. Contamination control station adjacent to Hot Line will be set up according to Figure 1.

c. Heavy paper or plastic sheeting shall be laid perpendicular to Hot Line (Figure 1) on which personnel exiting the hot area will stand for removal of protective clothing.

d. Heavy paper or plastic sheeting shall be laid parallel to and inside of the Hot Line for placement of instruments returning from hot area.

e. Five 55 gallon drums with large plastic bag liners will be placed in a line perpendicular to the Hot Line, Figure 1. These are for waste, cloth booties, coveralls and head covers, respirators and surgeon gloves.

3. <u>Entry in Contaminated Area</u>

It will be the responsibility of the team leader to be a final check on the dress-out of personnel entering the hot area. He should check for proper taping of protective clothing so that there are no exposed areas. Check shall be made also for proper fit of gas mask

4. <u>Return from Hot Area</u>

a. Personnel returning from hot area shall place all instruments and survey data on the heavy paper or plastic located inside the contaminated area (Figure 1).

b. Move to the hot exit in a single file and prepare for removal of protective gear.

c. Remove all tape from outer clothing and deposit in the waste receptacle (plastic bag).

d. Remove one shoe cover, have foot monitored for alpha and beta-gamma contamination. Step across the Hot Line with that foot and place the shoe cover in the shoe receptacle. Remove the other shoe cover, have foot monitored, step completely across the Hot Line with that foot and place the shoe cover in the shoe receptacle.

e. Remove outer gloves, outer coveralls and hood and place in the appropriate containers. In removing the outer layers care must be taken to avoid contaminating the inner coveralls with the gloves.

f. Undergo detailed monitoring of the entire body for both alpha and beta-gamma contamination. This monitoring begins with removal of the inner shoe covers (plastic bags) at the step-off line by a procedure identical to the removal of the outer shoe covers at the Hot Line. One shoe cover is removed, the foot monitored, and, if found to be free of contamination, the foot is placed across the step-off line and the shoe cover placed in the receptacle. The same process is used for the other foot. Then on the clean side of the step-off line, the entire body is monitored as the respirator, inner coveralls and gloves are removed. Special attention is paid to the neck, hands and feet. If any contamination is found at any point in this detailed monitoring (beginning at the step-off line), the monitored individual proceeds directly to the decontamination station, as indicated by the dark arrows (Figure 1).

g. Nose swipes shall be taken. A urine sample will be collected if internal contamination is suspected.

h. As the final step in the sequence, thoroughly wash the face, neck and hands; follow this as soon as possible with a complete body shower.

5. <u>Decontamination Station</u>

The decontamination station in an emergency situation will be primitive at best. This will probably only include water and soap with basins, and scrub brushes for superficial decontamination. Any difficult decontamination will necessarily have to wait for shower facilities which will not likely be available at the Hot Line.

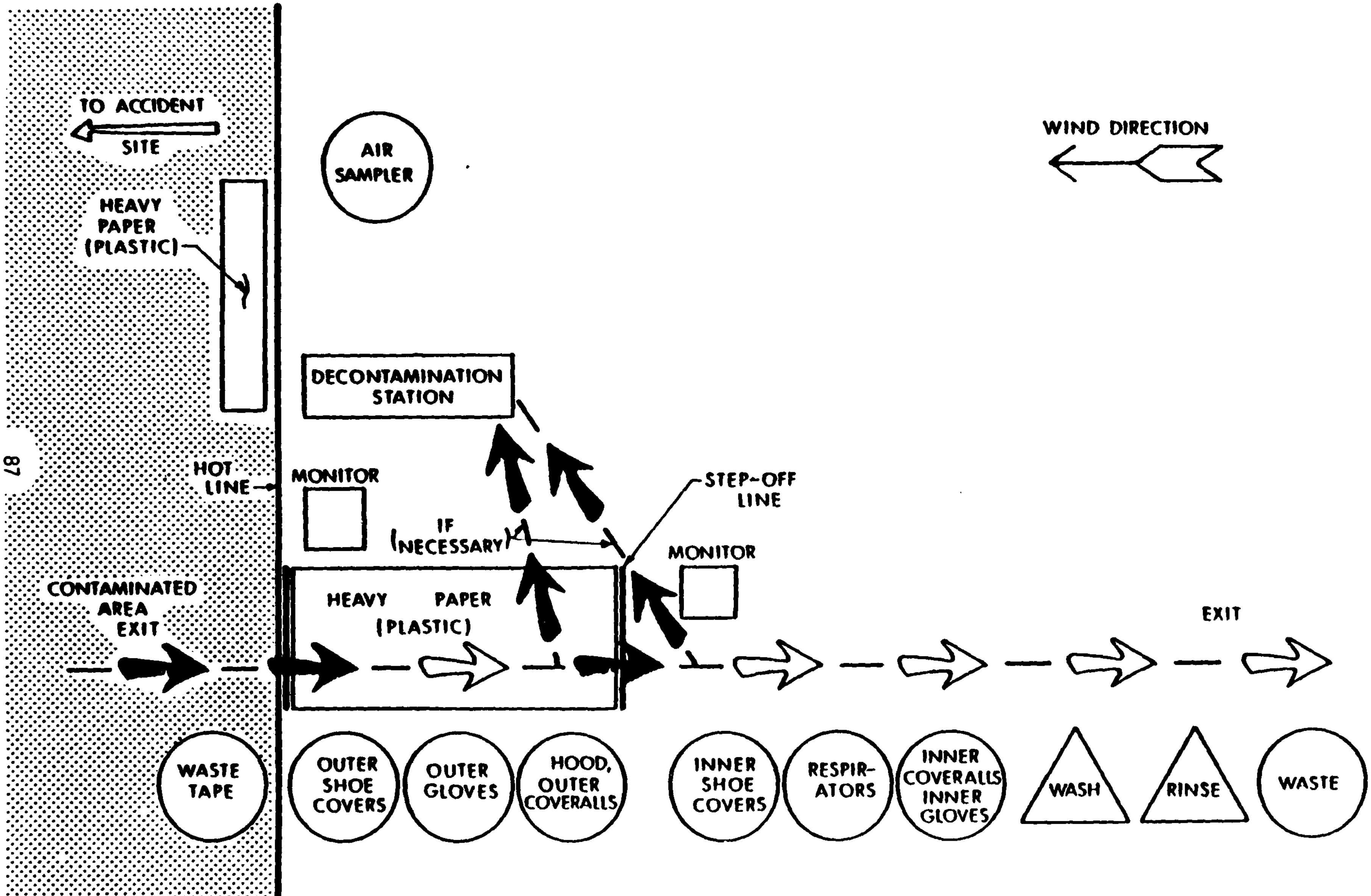


FIGURE. 1. CONTAMINATION CONTROL STATION (CCS)

PAC-1 SAGA METER

- *AC-3 ALPHA SCINTILLATION PROBE*
  - •• 0 to 2×10^6 CPM
  - •• 59 cm^2 SAMPLE AREA
- *PG-1 GAMMA SCINTILLATION PROBE*
  - •• LOW ENERGY (10 - 150 keV)
  - •• 5 cm^2 SAMPLE AREA
- *INTERNAL GM DETECTOR*
  - •• 0 to 2R HIGH ENERGY GAMMA (0.1 - 1.5 MeV)

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APPENDIX H

RADCON Post-Exercise Comments and Recommendations

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Unrealistic Survey Simulation

In this exercise, the simulation of measurement of contaminant was done by having controllers accompany radiation monitors, telling the monitors what readings they were getting on their various instruments. This procedure was unsatisfactory. RADCON and Sierra Alpha Team members who had participated in more realistic exercises (e.g. NUWAX 83) realized the difficulty and importance of instrumentation considerations which were not even addressed here.

Recommendation: A possible solution may lie in the judicious use of pieces of depleted uranium to provide actual "measurement points." It appeared to the Team that safety, surety and convenient control of readings could be arranged at a reasonable expense.

Escort at Arriving Airport

The support of Mr. Bob Folkes was excellent: In spite of the ridiculously poor GSA automobiles and vans which he was forced to offer to us, we moved expeditiously through the tangle of O'Hare airport and surrounding Chicago and proceeded without wasting time to the obscure exercise site totally because of his personal guidance.

Recommendation: Emphasize establishing an escort to meet the RADCON Team as part of the response procedure. Since RADCON generally makes its own travel arrangements after notification, this procedure might require the establishment of a POC at the accident site with the authority to dispatch an escort.

Aerial Photographs

Current aerial photographs of an accident site are ESSENTIAL. As pointed out in our RADCON recommendations, the old maps and phony photos were not adequate for planning survey routes and reporting data.

Recommendation: Since the cost of such photos should be low compared with the expenses of such an exercise (to say nothing of the costs associated with the "real thing") and since the use of such photos could enhance nearly every aspect of the response activity, we strongly recommend the taking and widespread distribution of such photos as a standard procedure in the Broken Arrow response.

Local People

We should anticipate taking advantage of local personnel and support.

Recommendation: Include local support in plans, exercises.

Radios - again

Again, the RADCON General Electric two-way radios proved impotent over the not-all-that-great an area which would be involved in an accident.

The avoidability of the situation was very apparent since the RADCON Team was also provided by the exercise support staff with two Motorola handsets which proved to be easily capable of transmission over the required few miles range. Unfortunately, the hand-receipt listed them as $3.3k.

Recommendation: We should look again to improve our capability: it can be done.

How many RADCONers?

Even with alpha team augmentation, a RADCON Broken Arrow response team of only nine people is stretched too thin. The brainstorm session identified the following eight people which should be kept on the COLD SIDE throughout the affair:

1. Team Leader
2. Assistant Team Leader
3. Air Sample Taker, Data Recorder and Coordinator (2)
4. Survey Data Recorder
5. Communication Point at Hotline
6. Alpha/RADCON Liaison - Hotline Director
7. RADCON Laboratory Specialist (Spectrometer, Swipes, Liq. Scint., etc.)
8. Electronic and Other Equipment

If, in addition, one provides for a reasonable number of survey team leaders for the HOT SIDE, one quickly has surpassed our standard nine-person response team.

In this exercise, job #3 was largely done by the alpha team. The team leaders and various team members "doubled" into jobs #4, 5, and 6. Job #7 and the electronic part of job #8 were simulated.

Procedures for Equipment Set-up

A "cook-book" for the set-up of instrumentation is essential for the RADCON survey equipment. If Cliff Taylor is not available and we can't "cram for the test" as we did for this exercise, we would be in deep trouble.

Exercise Realism

See Appendix F.

Alpha/RADCON

Integration of the Alpha and RADCON Teams was excellent. Joint practice paid off!

However, one must also recall that the NAICO was, in "real life" the boss of the personnel who make up the Alpha Team and knew their limitations. The NAICO was also a knowledgeable individual in the FM 3-15 concept of 1) Alpha respond, 2) RADCON show-up and take over, 3) Alpha becomes integrated into RADCON under RADCON leadership.

Recommendation: We should be sure that the RADCON leadership of radiological control activities is based not only upon technical superiority (which might not be known to a naive NAICO or an overly-ambitious Alpha Leader), but also upon formal arrangements.

Location Finding

DOE claimed some sort of intrinsic location finding and reporting built into their FIDLER equipment (which they did not bring). Called "Ranger," their system might provide an extension of our capabilities- or at least give us some ideas.

Incidentally, DOE never even showed up at the contaminated area. The DOE participation was totally at the EOC and - SIMULATED - in widespread surveys in the civilian areas downwind of the accident. Is that SOP?

Computer at the HOTLINE

Recommendation: We MUST investigate many possible applications of computers at the HOTLINE. Possibilities: Keeping track of egress and exit, recording dosimeters, recording data transmissions from the hot area.

COL ?, who apparently has a computer-applications project at DNA, brought some field computers to the accident to look for applications. In discussions with Dr. Klopcic, the COL was very enthusiastic about getting someone (for whom he would pay(?)) to program a field computer with user-friendly software for hotline maintenance.

Computer at the RAD HQ (the RADCON Tent at the Hotline)

Same as above. Klopcic did tell the COL from DNA that the state-of-the-art in graphics for micros is not yet potent enough to support the RADCON survey data recording with the maps and charts for location locating. However, immediate applications exist as a communication device, word processor (see Appendix E), calibration and standardization aid (see Appendix D), etc.

Fixing Agents

Someone should learn about new developments in "fixing agents." For example, the Forest Service uses some sort of green goo to hold the earth on embankments while new grass gets established. We should be expert in the area.

Super Sucker

Similarly, we should learn what equipment/techniques might be available for clean-up. Maybe the industrial world has progressed beyond front-end-loaders and 55-gal drums.

Coordination with NAICO

Our coordination with the NAICO/Asst. NAICO was excellent. However, the deck was stacked in our favor. We should, at every opportunity, stress the need for CONSTANT contact with the NAICO to establish and maintain a two-way pipeline to the OSC.

The NAICO was Responsive

A good example of this observation was the NAICO's prompt action to get us a tent which we set up at the Hotline. This established an unambiguous coordinating center for all MwAD survey activity and data - a fact that MG Hissong appreciated.

Radio Net

One error in our integration into the scenario: we were never read into the radio net. However, the Alpha Team was, and continued to function as a node in the net. In actuality, that node should have passed to the RADCON Team, since Alpha ceases to exist as an independent entity upon arrival of RADCON. This is an example of the discussion under point #9.

Survey Party Leader

It is important, in setting up survey parties, to identify the party leader, through whom all communication and instructions should be funneled.

Return to Hotline

Survey parties, and party leaders in particular, should not be afraid to return to the Hotline in case of problems that cannot be easily solved by radio. Spending excess time standing in the hot area - in RADEX gear - is more frustrating than an extra trip back to the hotline.

RADCON IDs

It was pointed out that we were never asked for positive identification. (That is a foul-up by the NAICO or someone. On the other hand, the NAICO's people know us personally.)

Marking Clean Roads

If we are to get involved in Super Sucker operations - which were essential in this scenario - we should also be aware of the means of marking those roads which have been cleaned. e.g. Highway departments routinely mark roads to be painted.

It is also necessary to understand the meaning of a swept road in an otherwise contaminated area. One may not assume that the road will stay clean - nor that vehicles which have traversed such roads may be assumed to be clean. However, it appears reasonable that traffic on such roads will not result in a resuspension hazard which was the necessary and sufficient reason for the cleaning process being done.

Badges

In addition to the cute - albeit sometimes inconvenient - RADCON jumpsuits and caps with which the Team is supplied, it would be beneficial to have a rather large, permanent (laminated) badge for each member. An example of such might be:

U.S.ARMY
RADCON Team
Mr. Upin Atom

There were several occasions at the EOC at which the RADCON Team Leader was more appropriately dressed in street clothes rather than field gear; however, not having his field gear on cost him the advantages of instant identification. (The benefit of being able to identify the RADCON Team, et al. was mentioned in the after-action briefing by Roeder, DOE.)

Pockets/Slits

Since the new jumpsuits have no slits through which an individual can reach the pockets of his underlying shorts/shirt, it is necessary to transfer items to the suit pockets (which are not particularly secure if one is physically active) or do without. Several members inquired about the possibility of getting outfits with pocket slits or getting the current ones tailored.

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